IMPROVING RELATIVE COMBAT POWER ESTIMATION:
THE ROAD TO VICTORY

A thesis presented to the Faculty of the U.S. Army
Command and General Staff College in partial
fulfillment of the requirements for the
degree

MASTER OF MILITARY ART AND SCIENCE
General Studies

by

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Fort Leavenworth, Kansas
2014-01

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*
13-06-2014

2. REPORT TYPE
Master's Thesis

3. DATES COVERED *(From - To)*
AUG 2013 – JUN 2014

4. TITLE AND SUBTITLE
Improving Relative Combat Power Estimation: The Road to Victory

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
CPT Rosen R. Kanatliev

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
U.S. Army Command and General Staff College
ATTN: ATZL-SWD-GD
Fort Leavenworth, KS 66027-2301

8. PERFORMING ORG REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for Public Release; Distribution is Unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT
War is a violent struggle between two opponents who use combat power to impose their own will on the adversary. The outcome of war is determined by the ability of those opponents to amass supeiror combat power in time, space, and purpose. Thus, the correct relative combat power estimation appears to be the main part of success in any campaign, battle, or engagement.
The problem of precise relative combat power estimation is presented in the study as a component of any level of war. At the strategic level the problem relates to creating and maintaing force design superior to the anticipated threat. At the operational level it supports the shaping of the battlefield or battlespace to create a favoreble balance. At the tactical level the correct estimation of relative combat power supports the decision making process and the efficient allocation of available resources.
The paper examines relative combat power as comprised of three main pillars: numerical preponderance, technology, and force employment. It reveals the limitations in some existing models for relative combat power estimation. This is a qualitative research effort that accommodates the logic of ends, ways, means; structured, focused comparison, and the US Army Design Methodology As a result of the analysis, the author proposes a way to measure variables currently assumed as intangible and bounds his logic in a simple mathematical equation.

15. SUBJECT TERMS
Relative Combat Power Estimation, Combat Power, Military Decision Making Process, Force Design, Numerical Preponderance, Technology, Force Employment.

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			19b. PHONE NUMBER *(include area code)*
(U)	(U)	(U)	(U)	96	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. Z39.18

MASTER OF MILITARY ART AND SCIENCE

THESIS APPROVAL PAGE

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ABSTRACT

IMPROVING RELATIVE COMBAT POWER ESTIMATION. THE ROAD TO VICTORY. by CPT Rosen R. Kanatliev, 96 pages

War is a violent struggle between two opponents who use combat power to impose their own will on the adversary. The outcome of war is determined by the ability of those opponents to amass supeiror combat power in time, space, and purpose. Thus, the correct relative combat power estimation appears to be the main part of success in any campaign, battle, or engagement.

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ACKNOWLEDGMENTS

This work is dedicated to my loving wife Maria, and my daughter Ralitsa. Without their unwavering support, encouragement, patience, and understanding the completion of this thesis would not have been possible.

I am also deeply indebted to my thesis committee of Mr. Mark Wilcox, LTC Shane Perkins, Dr. Frank James, and Mr. Lowell Solien. Their constructive feedback guided me through the challenge of writing and defending a Master's thesis in a foreign language. I highly appreciate their work and their valuable time spent in reading the numerous drafts that were produced.

Lastly, I would like to take this opportunity to thank all those instructors and colleagues who have made my knowledge of military art and science much broader. Thus, they all indirectly have influenced me and my work.

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ACRONYMS

COA	Course of Action
CP	Combat Power
EOF	Similar Operational Force Employment
ETF	Similar Tactical Force Employment
MDMP	Military Decision-Making Process
OF	Operational Force Employment
RCP	Relative Combat Power
SFE	Superior Force Employment Factor
SOF	Superior Operational Force Employment
STF	Superior Tactical Force Employment
TF	Tactical Force Employment
TTPs	Tactics, Techniques, and Procedures
WfF	Warfighting Function
WfFs	Warfighting Functions
WW I	World War One

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CHAPTER 1

INTRODUCTION

> A good general not only sees the way to victory; he also knows when victory is impossible.
>
> — Polybius

Background of the problem

The ambiguity and unpredictability of war is evident in the experience of thousands of years of battles. War is a violent struggle between two opponents that use combat power to impose their will on the adversary. Throughout human history military theorists have tried to predict the outcomes of battles and wars. They have tried to find the road to victory. Directly or indirectly, they have concluded that possessing superior combat power leads to success. As one of them, Brigadier General (Retired) Huba Wass de Czege wrote, “The outcome of campaigns, battles and engagements . . . is determined by the relative combat power of the adversaries at the point of decision.”[1]

In war both opponents strive to achieve favorable outcomes in military struggles. On any level of war–tactical, operational, or strategic–military leaders and policy makers face the same problem: What amount of resources should be allocated in order to achieve the desired end state? The answer to this question is connected to combat power estimation. It seems easy to determine enough resources in order to build superior combat power at the decisive point. The reality however is different. Clausewitz stated: “Everything in war is very simple, but the simplest thing is

[1]Huba Wass de Czege, “Understanding and Developing Combat Power” (Paper, 1984), 7.

difficult."[2] That is the core of this thesis's problem. Precise combat power estimation has proven to be much more difficult than it seems.

The complexity of this problem arises from its essence–combat power is always relative, never an absolute, and has meaning only in comparison to that of the enemy.[3] The relativeness is defined by many tangible and intangible variables that interact in order to produce comparable results. Objective assessment of all the variables is not always possible. Subjective assessment, by itself, bears the risk of misinterpretation. Decision makers and planners at all levels of war need to consider this relative estimation, or ratio, as it is a mandatory part of any planning process.

There are different methods for modeling the relative comparison. All of them have their logic and scientific explanation. To the author's knowledge, there is no single model that fully encompasses the three main aspects of combat power - numerical preponderance, technology, and force employment. Likewise no existing model fully encompasses the elements of combat power as determined by current doctrine. This leads to an important conclusion: Military planners are using too much intuition-based subjectivism when conducting relative combat power estimation. This study aims to address this situation by focusing on incorporating preponderance, technology, and force employment in relative combat power estimation.

Research Question

The research question for the study is: How to improve relative combat power estimation? This primary question is oriented toward the plausible, practical use of research. The answer to the main question would include a model for combat power

[2]Carl von Clausewitz, *On War* (Princeton: Princeton University Press, 2008), 119.

[3]Wass de Czege, 7.

estimation and comparison that may be applied in the planning process. This model will incorporate numerical preponderance, technology, and force employment. Several secondary research questions address specific aspects of the proposed problem:

1. What are the current models for measuring combat power? Several models are found in the literature. They will be discussed mainly in the context of the Warfighting Functions (WfFs), as set out in U.S. Army doctrine, and force employment. There will be no analysis of the internal dynamic, nor will the given values to the various weapon systems and/or units be debated.

2. What is the dynamic between numerical preponderance, technology, and force employment? The hypothesis that is used to develop the model for relative combat power estimation and comparison will emerge from the answer to this question.

3. How to operationalize that dynamic? This third subordinate question is focused on finding measurable factors that can be used in a simple mathematical equation.

Scope

The focus of this paper is to review the existing models for relative combat power comparison, to identify gaps in them with respect to the elements of combat power and force employment, and to propose a model that fills these gaps. The study analyzes the correlation between numerical preponderance, technology and force employment from the perspective of balance among the WfFs. Exploring the interaction among the three aforementioned categories from the perspective of WfFs represents a different approach to the thesis problem. Based on the analysis made in chapter 4, this study also offers a recommendation for incorporating technology and force employment in the methods or models for combat power estimation. The identified gaps and the analysis made in chapter 4 form the basis for the recommendation. The proposed model will be presented as a simple mathematical equation.

Assumptions

Several assumptions underpin the conduct of this study. These assumptions are not controversial within any historical trend that emerged through the research phase. Their purpose is to support some explanatory sections in the analysis chapter. They should not be accepted as evidence or evaluation criteria.

Assumption 1: The numbers in figure 3 in chapter 4 of this thesis, “Historical Force Ratios,” correctly satisfy massing requirements for each mission’s success. The numbers are accepted as a standard, which should be achieved. This will help the author to explain the gaps in existing models. In the analysis chapter, the study argues that failures in battles are the consequence of incorrect estimation of relative combat power.

Assumption 2: The commander and his staff may achieve victory in battle if they correctly estimate required relative combat power and allocate resources properly. Conversely, miscalculation of the relative combat power assessment will lead to inaccurate or inefficient use of resources and so may lead to defeat.

Assumption 3: Warfighting Functions (WfFs) include sophisticated systems that represent the technology level in their areas. The technology level of a system determines it capabilities. The capabilities are tangible (and therefore measureable), and the effects of the capabilities are subjective values that could be assigned to any given situation. This assumption is important to the study, as it creates conditions to incorporate the elements of combat power into a mathematical equation.

Definitions

The terminology in the study is that found in the doctrine of the U.S. Army. However, several additional terms are also used in the paper. Following is a list of key doctrinal definitions and also the new terms with their explanations. These terms are an integral part of the research.

Combat power: The total means of destructive, constructive, and information capabilities that a military unit or formation can apply at a given time.[4]

Force employment: The way units and formations are used in operations, battles, and engagements to achieve victory. Force employment encompasses a range of factors. They include but are not limited to doctrine and manuals, training and leadership, morale strength, and tactics, techniques and procedures (TTPs).

Leading role in WfFs: The leading role in WfFs is awarded to the WfF that has the most significant influence in shaping military strategy for a given time in history. Explanation: The shift of leading role in WfFs has iccurred several times over the last 400 years. It has been correlated with different developments in technology, society, and the needs of the time. This term is crucial for the thesis as it allows the author to integrate force employment into a proposed mathematical equation. Several historical examples are provided in chapter 4 to make its visualization clear.

Similar force employment: Employment of forces in a doctrinal and standardized way by the both opponents.

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[4]Headquarters, Department of the Army, ADRP 3-0, *Unified Land Operations* (Washington, DC: Government Printing Office, 2012), 3-1.

Superior operational force employment (SOF): Employment of forces with a superior organizational structure that utilizes the leading role in WfF as compared to an opponent. The author argues that there is significant difference between two opponents when they use force design built upon leading role of different WfF. In that case one of those two opponents uses SOF relative to the other.

Superior tactical force employment: Employment of forces in a new and unexpected way for the opponent, which allows an optimal use of a new technology's capabilities.

Superior warfighting system: Aa system that incorporates the contemporary achievements of science into force design and simultaneously adopts military doctrine to achieve maximum effect from the balance of the WfFs. Authors like Stephen Biddle, Ryan Grauer, and Michel Horowitz use the term "modern system;" a term that has appeared in the literature with the same meaning for the last century, a potential source of confusion the reader. Superior warfighting system is a relative term. It has meaning only when comparing two or more warfighting systems. Superior warfighting system may result only if there is existence of either superior tactical or superior operational force employment. Chapter 4 provides further discussion of the term.

Warfighting function (WfF): A group of tasks and systems (people, organizations, information, and processes), united by a common purpose, that commanders use to accomplish missions and training objectives.[5]

WfFs balance: The WfFs balance is the relative weight of any of the WfFs in shaping military strategy for a specific time in history. The importance of any WfF

[5]Ibid., 3-2.

varies through time and is dependent on factors like level of technology, socio-political environment, organizational structure of military formations and others. It is a fluid and evolving mix and its evolution is reflected in military doctrine.

Limitations and Delimitations

This paper' spanis limited to the gaps in existing models for comparison of relative combat power. Its purpose is not to argue the inherent validity of those models or to examine and validate their inherent logic. This thesis is conducted as an objective effort to discover the utility of all combat power building aspects into some of the existing models. It should be seen as an addition to them, not as a replacement. Empirical testing of the proposed method to incorporate the WfFs and force employment is not part of the study, so it will require separate research.

This research is subject to two limitations. First, the literature for the problem was sufficient, but the preliminary part of it does not propose a way to solve the problem, but merely acknowledges its existence. The works that presented new or different ideas were rare. The second limitation was due to security issues. The paper does not contain classified subject materials, nor has the author used classified information to derive his conclusions. This limitation influenced the research, as it did not allow for a thorough examination of combat power estimation models currently in use by the U.S. Army and other armed forces.

Significance of the study

An understanding of combat power estimation is essential for planning military operations. WfFs are core elements of combat power and so they have significant meaning when we discuss that topic. They are well defined and their capabilities are measurable. All these capabilities create effects on the battlespace.

The possible effects and their meanings are the objects of an analysis that enables the planner to assign to them quantifiable variables. However, the correlation of WfFs with technology, numerical preponderance, and force employment is still not clearly represented in the models that are applied in Military Decision-Making Process (MDMP).

Existing models, for example the relative combat power matrix, propose a relative analysis of combat power elements (or their analog in 1995), but the result of it is highly subjective.[6] The answer to, "So what?" remains ambiguous for the majority of the planners. Force employment is is highly important for this paper. However, measurable variables with respect to force employment are not really applied in the process of combat power ratio analysis. Most of the models rely on commanders' ability to use weapon systems to their full potential. This is a huge assumption, which has proven wrong at least half the time (defeated side in any battle). This study will propose a model that will be useful in two ways. First, it may help improve staffs' planning and decision making processes. Second, it may provide an alternative approach for combat power oriented force design.

Summary

The background to this problem shows that military planners are still using too much intuition-based subjectivism when conducting combat power estimation and comparison. Decision makers need to possess a more reliable method for modeling in that field, one that will allow them to allocate overwhelming combat power throughout battlefields and theaters of operation. The primary research question is

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[6]Brian D. Barham, "What is Relative about Combat Power?" (Monograph, School of Advanced Military Studies, Fort Leavenworth, KS, AY 94-95), 23.

focused on adding additional factors to the existing models. A model that incorporates numerical preponderance, technology, and force employment may prove more reliable. Subordinate questions logically address different aspects of the study. They allow the author to explain the existing gaps and suggested ways to fill them.

The scope of the study is narrowed to a single but significant problem. The paper aims to propose useful and applicable solutions to it. This is done by presenting the results of the analysisin a simple mathematical equation. The equation is empirically based as it elaborates upon already existing and doctrinally determined methodologies. Several definitions were given, some of which are doctrinal terms and others are new definitions that support the explanations and analysis in chapter 4. Limitations and delimitations of the study do not significantly influence its results. The thesis was oriented on improvements to two activities: decision making and force design.

A review of the relevant academic and official literature follows in chapter 2.

CHAPTER 2

LITERATURE REVIEW

> But courage which goes against military expediency is stupidity, or, if it is insisted upon by a commander, irresponsibility.
>
> — Erwin Rommel

The purpose of chapter 2 is to review the extant literature on combat power estimation and to outline the primary and secondary source material used to answer the question: "How to improve relative combat power estimation?" The literature also addresses the secondary research questions. It is arranged according to key works in the field, some professional studies on the problem (including official documents, such as military doctrine), and the major trends in the scholarship.

Key Works

Throughout the centuries of human history philosophers, warlords, and scholars have discussed and exploited the problem of relative combat power and its estimation. This problem was central any time a war was close. It is not coincidence that the most famous ancient military theorist, Sun Tzu, paid attention to the concentration of forces. He was clearly had in mind numerical preponderance and its meaning during a battle when he wrote, "We can form a single united body, while the enemy must split up into fractions. Hence there will be a whole pitted against separate parts of a whole, which means that we shall be many to the enemy's few."[7] Aristotle in his *Rhetoric* paid special attention to relative combat power and its importance for the leader of the country: "He (the leader) should know, too, whether the military

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[7]Sun Tzu, *The Art of War, Sun Tzu, The Oldest Military Treatise in the World, Translated from the Chinese,* with an Introduction and Critical Notes by Lionel Giles, M.A. (Assistant Department of Oriental Printed Books and Manuscripts, British Museum. 1910), 68.

power of another country is like or unlike that of his own; for this is a matter that may affect their relative strength."[8] He also wrote about leadership and its impact on military situations, emphasizing the appeal to ethos, pathos, and logos of the followers as a tool to gain their commitment.[9] This reflects motivation and its relationship to force employment. Ancient linear warfare hardly touched the complexity of modern war, but the principles of Sun Tzu and Aristotle, including their observations about combat power estimation and force empoloyment, remain valid.

Napoleon also offered thoughts about combat power and superiority whe he said, "God is on the side of the big battalions."[10] He presented a point of view that was based preferably on a favorable imbalance in numbers and force ratio. For him, as for Sun Tzu, the essence of superior combat power is the ability to mass forces against a relatively weak point of the enemy force. However, Napoleon did not think one-sidedly about the problem. He also said: "The moral is to the physical as three to one."[11] This dual nature of a force's combat power is inherent to the problem and was appreciated by the military theorists who based their thinking on the study of the Napoleonic Wars.

In the 19th century military thinking was strongly influenced by Napoleon and his wars. The main problem with combat power estimation was the dichotomy between masses and moral strength of the soldiers. Antoine-Henri De Jomini

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[8]Aristotle, *Rhetoric by Aristotle,* trans. W. Rhys Roberts (The Pennsylvania State University, Electronic Classics Series, 2010), 20, http://www2.hn.psu.edu/faculty/jmanis/aristotl/Aristotle-Rhetoric.pdf (accessed 21 May 2014).

[9]Ibid., 9.

[10]John Bartlett, *Familiar Quotations,* 10th ed. (Boston: Little Brown, 1919), no. 9707.

[11]Richard Moor, *Napoleonic Guide,* http://www.napoleonguide.com/maxim_war.htm (accessed 21 May 2014).

describes his elements of combat power as twelve essential conditions that interact to form a perfect army. Among these conditions are: "A good organization . . . Good combat, staff, and administrative instructions . . . [and] to have an armament superior, if possible, to that of the enemy, as to both defensive and offensive arms"[12] The conditions for creating Jomini's perfect army include elements of organizational structure, doctrine, force employment, and technological superiority. Another essential thought that arises from his work is that the force design of the perfect army should follow these conditions that create combat power.[13] Another French army officer and military theorist, Charles Ardant du Picq, focusing on the effect of moral force, wrote that not only the numbers count, but, "Today, numbers are considered as essential. . . . We assume that all the personnel present with an army, with a division, with a regiment on the day of the battle, fights. Right there is the error."[14]

Carl von Clausewitz made a serious attempt to explain the correlation between numerical preponderance, technology and force employment. The wars during the time that he lived and the level of technology developments formed his position. He stressed that combat power is based on numbers: "In tactics, as in strategy, superiority of numbers is the most common element of victory."[15] However, he also offered a comprehensive analysis ofdifferent factors that influence combat power. Some of the

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[12]Jomini, "Art of War," in *Roots of Strategy, Book 2: 3 Military Classics, All in One Volume, du Picq's Battle Studies, Clausewitz's Principles of War, Jomini's Art of War,* ed. Brig. Gen. J. D. Hittle, trans. John N. Greely and Robert C. Cotton (Mechanicsburg: Stackpole Books, 1987), 450.

[13]Ibid.

[14]Ardant Du Picq, "Battle Studies," in *Roots of Strategy, Book 2: 3 Military Classics, All in One Volume, du Picq's Battle Studies, Clausewitz's Principles of War, Jomini's Art of War,* ed. Brig. Gen. J. D Hittle, trans. John N. Greely,and Robert C. Cotton (Mechanicsburg: Stackpole Books, 1987), 157.

[15]Clausewitz, 194.

factors that he pointed to are courage and morale, superior organization and equipment, superior mobility, and novel tactics. For Clausewitz, when the opposing systems are similar or equal in numbers and capabilities, "the only remaining factor that can produce marked superiority . . . consists of the talents of the commander-in-chief."[16] Using a comprehensive approach to the problem, he summarized the correlations that form combat power: "The decisive importance of relative strength increases the closer we approach a state of balance in all the above factors."[17] The nineteenth century military thinkers made a significant contribution to the problem and formed the basis to its further study during the next hundred years. Overall, from ancient times to the beginning of the twentieth century, three pillars of combat power emerged: numerical preponderance, technology, and force employment.

The twentieth century witnessed an increased interest in the field of operations. Modern armies tried to employ a variety of scientific methods and mathematical models to support analytical activities related to planning and operations. During World War One (WW I) Frederick Lanchester devised a series of differential equations, and among them was an equation that became known as Lanchester's Square Law. He argued that long-range delivery capabilities of contemporary weapons allowed the concentration of fire power on a small amount of enemy weapon systems. Furthermore he was able to transform his words into mathematical terms. Consequently, the results of his work showed that "under 'modern conditions' of warfare there is an advantage to concentrating forces (i.e.

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[16]Ibid., 282.

[17]Ibid.

reduction of own casualties from committing more men to battle)."[18] Lanchester's theory subsequently formed the basis for most of the contemporary models for combat power estimation and force-to-force attrition. The importance of Lanchester's theory for the present study is not in the results of his equations, but in the equations themselves. The form that is useful for the military practitioners in order to estimate combat power became a simple mathematical equation.

Several works of academic literature that proved useful for the current research, in regard to force employment, were the books *Military Power. Explaining Victory and Defeat in Modern Battle* by Stephen Biddle, *The Diffusion of Military Power Causes and Consequences for International Politics* by Michael Horowitz, and Ernest May's *Strange Victory: Hitler's Conquest of France*. May's historical book shows that simple measurements of forces like troop counts or the counts of particular technologies like tanks or planes do not always predict the outcome of the battles. Biddle's theory of the significance of force employment presents a new approach to relative combat power estimation. In his study he critiques the orthodox theories and focuses on the correlation between force employment and combat power estimation. He emphasized a modern system of warfare and its effect on battles. Biddle, using computer supported simulation, developed his theory for the effect of force employment. Part of his analysis was used in chapter 4 of this paper.

Like Biddle, Horowitz points to the importance of employment. However, he stresses the organizational dimensions and their impact on adopting new technologies. Horowitz derives direct correlation between technology and force employment: "The combination of new organizational approaches to the employment of force and new

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[18]James G. Taylor, *Lanchester Models of Warfare*, vol 1 (Monterey, CA: Naval Postgraduate School, 1983), 62.

technologies can produce increases in military power that are much larger than the sum of their parts."[19] These contemporary authors appear to be in agreement on the need for employment to be incorporated into relative combat power estimation.

The first step in the review of literature was to identify the main ideas and trends in the area over time. In conducting this part of the research, the influence of these ideas to the current models and approaches to combat power estimation became clear. First, Sun Tzu's principle of massing remains indisputable. The importance of quantity is supported by Napoleon, Ardant Du Picq, Jomini, and Clausewitz. Thus, quantity or numerical preponderance presents itself as one of the three pillars of relative combat power. The second pillar is technology. Clausewitz and Jomini discuss the influence of technology on the outcome of battles. Their writings point to the importance of superior armament and the role of technology in relative combat power. The third pillar is force employment. All of the theorists acknowledge this factor, but describe in different forms: the importance of leaders and generals, morale, or organization. Contemporary authors like Stephen Biddle and Michael Horowitz place the emphasis clearly on this factor as a component of an adequate estimation of relative combat power.

The interaction between preponderance, technology, and force employment appears to have significant importance for relative combat power estimation. The review of the previously mentioned key works points to the existence of such an interaction, but it remains ambiguous and few attempts have been made to measure it. The most significant contribution to understanding this phenomenon was made by

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[19]Michael C. Horowitz, *The Diffusion of Military Power. Causes and Consequences for International Politics* (Princeton: Princeton University Press, 2010), 209.

Biddle, however it is not clear enough. This stater of the extant literature strengthened the researcher's impression that the main hindrance to improving relative combat power estimation is the gap in the dynamic between preponderance, technology, and force employment.

Professional Studies

The review of professional works on the problem was focused on monographs and theses. The challenge here was to identify those, which contribute to the research. Applying critical reading was necessary to extract useful information. A careful reader will notice the influence of the work of BG (Retired) Huba Wass de Czege. In acknowledgement of this influence, the author took a close look at his work, too. The review of professional papers was oriented on finding works that suggested or attempted to contribute to filling the existing gaps in combining numerical preponderance, technology, and force employment. The monographs and theses offered different points of view, and several papers contributed to the current study. The limited number of monographs facilitate this research, address the primary research question and highlight and exploit the vulnerabilities of existing models for combat power estimation. However, they do not fully address the correlation of force employment and the balance among WfFs in respect to the combat power of a military organization. The evaluation of these studies reveals problems in implementing a working model for combat power estimation that is simultaneously simplified enough to be used for planning purposes and reliable enough to serve for policy making and force design.

Of all the professional works, Wass de Czege's *Understanding and Developing Combat Power* most directly facilitates the current research. He forms a logical framework for evaluation of combat power elements. His work is fundamental for much of the research on the problem. Wass de Czege divides the effects of combat power into four groups: Fire Power, Maneuver, Protection and Leadership.[20] Thus he forms a solid base for examining the problem. He presents a simple mathematical model that represents the complex interaction among the effects of combat power. Although his logic encompasses all the elements of combat power, it is problematic, in that he multiplies the sum of combat power elements by leadership. The real problem in his work is that he did not offer a way to measure leadership, which makes the results of his equation dependent on a single, intangible variable. A revision of this model from the perspective of WfFs might offer ideas for accurately addressing the challlenge of estimating relative combat power.

Brian D. Barham's and David V. Boslego's 1995 monographs focus the research on the technological capabilities of the elements of combat power and their effects that are aspects of combat power relative to an enemy at the operational and tactical level. Both authors point to the need to refine the military decision making process, which requires planners to consider relative combat power with respect to its elements. Boslego examines information and its technological effects on force employment. Barham presents a relative combat power matrix and discusses the effects Wass de Czege identified in his study. However, neither work offers a clear answer to the "so what" question. The relationship between the combat power matrix and the comparison by force-to-force ratio remains unclear. With the matrix, Barham makes an attempt to compare the elements of combat power of two opponents, but does not offer a way to include the results in an equation. Nonetheless, his, Boslego's

[20]Wass de Czege, 12-14.

and Wass de Czeg's studies give practical suggestions for combat power estimation that support the decision making process.

Two other monographs by David R. Hogg, from 1993, and James A. Zanella, from 2012, describe and compare different models of relative combat power estimation. Both highlight the gaps in existing models, and Zanella's stresses the mismatch between present U.S. Army doctrine and the methods of relative combat power estimation found in older versions. The value of these two works for the current research was mostly informative, as they do not present a new way of filling the gaps in the extant methodologies.

This step of the literature identified recent professional papers on the problem. Based on this brief review, and to the author's knowledge, military professionals are still in a search for improvements in reliability of relative combat power comparison models. Despite significant efforts to validate most of the current methods, the reliability of the existing models remains questinable. Further evaluation demonstrates that current models do not fully encompass all the aspects and elements that influence combat power. The review of professional papers confirmed the impression made by the key works review. To the author's knowledge, there is no model that encompasses preponderance, technology, and force employment.

Government Documents

The last subject of the literature review was current doctrine, and the way it addresses the research problem. A suspected shortfall in clarity and details prompted professional interest in the study. On the other hand the research pointed to the conclusion that the current doctrinal framework provides powerful tools to investigate and address the problem issues. This category of literature includes US Army and joint publications, manuals and doctrine.

U.S. Army Doctrinal Reference Publication (ADRP) 1-02 *Operational Terms and Military Symbols* provided the core of definitions used in the study. A few new terms were added in chapter 1 in order to facilitate the analysis in chapter 4. Doctrine is also the basis for the research as it points to the importance of the topic and its place in military art and science. Army Doctrnial Publicaiton (ADP) 5-0 and ADRP 5-0 *The Operations Process* clearly stress the importance of combat power to seize, retain, and exploit the initiative to gain a position of relative advantage.[21] Applying combat power is a core doctrinal activity for any military organization.

The definition of combat power and explanations of its elements rendered an anchoring point for the research. According to ADRP 3-0 *Unified Land Operations*, "Combat power has eight elements: leadership, information, mission command, movement and maneuver, intelligence, fires, sustainment, and protection. The Army collectively describes the last six elements as the warfighting functions. Commanders apply combat power through the warfighting functions using leadership and information."[22] The U.S. Army publications and manuals revealed that they do not restrict, but tend to support a flexible approach in exploiting the doctrine. The extant doctrine clearly defines the elements of combat power. It also thoroughly discusses each of the eight elements. Thus it became important to understand that a thorough knowledge of doctrinal postulates places at the researcher's disposition powerful tools to examine the thesis problem. The second part of the review of doctrine was focused

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[21]Headquarters, Departments of the Army, ADP 5-0, *The Operations Process* (Washington, DC: Government Printing Office, 2012), 1.

[22]Headquarters, Departments of the Army, ADRP 3-0, 1-9.

on identifying the current doctrinally acceptable methodology to execute the relative combat power comparison process. The research was limited to unclassified information, which places a limitation on this facet of the review of doctrine and processes. However U.S. Army Field Manual (FM) 34-130 *Intelligence Preparation of the Battlefield* from 1994 provided an example for the doctrinal methodology used by planners. The example that was used for calculating force to force ratio, although simplified, was doctrinally correct. Armies around the world may use much more complex methodologies for relative combat power estimation, but to the author's knowledge, the principles of the model explained in FM 34-130 remain unchanged. Thus the doctrine review provided tools to explore the proposed problem and a method for relative combat power estimation that do not contradict the thesis limitations.

Trends in Scholarship

Three major trends emerged from the literature review. First, when presenting a combat power estimation model, military theorists predominantly choose a decisive factor for their model. This factor represents one of the three main ideas that mostly influence combat power: numerical preponderance, force employment, and technology. Second, none of the existing models appear to meet the needs and requirements for relatively accurate prediction of the outcome of battles. Overall, military practitioners remain heavily dependent on subjective assessment in the process of relative combat power estimation. Integrating force employment and technology in existing models may reduce that gap and contribute to better decision making. Third, and first evident during the 20th century,the review of literature suggests that a useful model for relative combat power estimation could logically be represented in a simple mathematical equation, which should take into account numerical preponderance, technology, and force employment.

Summary

This literature review was made in accordance with the research question and addresses its needs. To the author's knowledge, the extant literature falls short in answering the research question. Chapter 2 briefly presents a few key works in the field, and some current publications on the topic. It also presents the doctrinal importance of the problem. At the end of the review, some trends are also briefly discussed. They emerged through the literature review process and, in some degree, they influenced the methodology of the research. The trends also influenced the construction of the analysis chapter as the proposed model tends to address them, and to fill the gaps that emerged. The design of the research is described in chapter 3.

CHAPTER 3

RESEARCH METHODOLOGY

> Every discourse, even a poetic or oracular sentence, carries with it a system of rules for producing analogous things and thus an outline of methodology.
>
> — Jacques Derrida

The research methodology chosen for this paper is a combination of three approaches. This is a qualitative research effort that accommodates the logic of ends, ways, means; structured, focused comparison, and the US Army Design Methodology.

Ends, Ways, Means

The “Ends, Ways, Means” model was used to exercise control over a set of data in order to achieve the goals of the paper and to answer the research question. The model provided proactive direction for the analysis chapter. The literature review supported the identification of the Means, i.e. the data. It supplied the inputs for the sequential use of the two Ways – structured, focused comparison and the Army Design Methodology. The data first supported the structured, focused comparison of selected case studies. The outcomes of the comparison were the inputs for the second step, or Way, the application of the Army Design Methodology. The result of the application of the Army Design Methodology was the proposed improved relative combat power estimation model – the Ends in the methodology. Figure 1 provides a graphic representation of the methodology used in chapter 4.

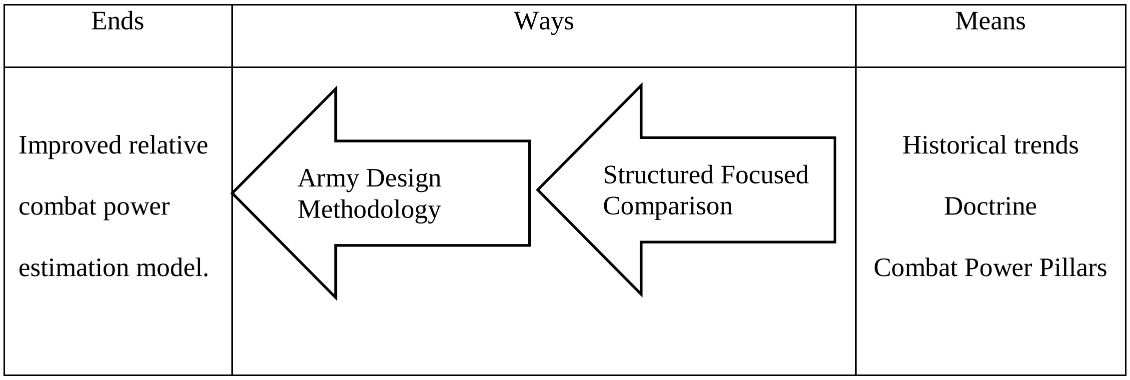


Figure 1. The logic flow of the "Ends, Ways, Means" model for chapter 4

Source: Created by author.

The contribution of this model to the research was significant. It provided methodological direction from the very beginning of the process to the proposed end product. It guided the literature review to provide the Means, or data, for the study. Thus the author extracted enough data to form the foundations for the analysis applied to answer the thesis question. The model also focused the efforts on a single problem by presenting a framework by which to narrow the scope of the research and to stay on track during the work.

Structured, Focused Comparison

The author adapted the methodology of structured, focused comparison to analyze extant models of combat power estimation. In 1979 Alexander L. George coined the expression "structured, focused comparison" to refer to a general method of theory development in qualitative, small- N research.[23] This method was adapted to the needs of

[23]Alexander L. George, "Case Studies and Theory Development: The Method of Structured, Focused Comparison," in *Diplomacy: New Approaches in History, Theory, and Policy*, ed. Paul Gordon Lauren (New York: The Free Press, 1979).

the study in order to determine the existing gaps, as it is a working comparison method that supported the analysis. The research began with the collection of data that may identify the major trends in relative combat power estimation. The key works presented in the literature review outlined these trends and provided the author with the core pillars of the study: numerical preponderance, technology, and force employment. This led to efforts to identify the gaps through a focus on professional works and US Army doctrine. The professional papers were examined from the perspective of the terminology and tenets of current doctrine, regardless of their publication date. As a result of this process three models of combat power estimation emerged.

The first model was a doctrinal example of relative combat power estimation. The example was thoroughly explained in US Army FM 34-130 *Intelligence Preparation of Battlefield* (1994). This model was selected for four reasons: it is an open source document and therefore easily accessible, it contains the principles of current models, it was doctrinally-based and used in practice by the US Army, and it generated results in a simple mathematical equation. The author believes that this first model correctly presents the major principles of relative combat power estimation. The second model was the product of BG (R) Wass de Czege's work. He thoroughly described and explained it in his study "Understanding and Developing Combat Power" of 1984. The author selected Wass de Czege's model for several reasons: it represents an approach to the problem that is different from the one found in FM 34-130, it was the first attempt to fully incorporate the elements of combat power into the relative combat power estimation process, its logic is much closer to the logic of current US Army doctrine than the earlier (FM 34-130) doctrinal model, although it was not applied in practice, and it, too, renders results in a simple mathematical equation. Although Wass de Czege published the study in 1984, the author concluded that its relevance to current doctrine will allow the comparison to reveal some of the existing gaps.

The last model is the Relative Combat Power Matrix. This matrix by itself does not represent a new model for relative combat power estimation. It is an addition to the existing models, which are constructed on the principles of the one found in FM 34-130. Several reasons led to the selection of the matrix for inclusion in the present study: the Relative Combat Power Matrix is currently used in MDMP, it presents a doctrinally accepted addition to the existing models, it compares the elements of combat power of two opponents, and it represents an attempt to combine the logic of the aforementioned first two models. The author concluded that this model would reveal nuances of the problem that are not evident in models one and two.

The application of structured, focused comparison for analyzing the three models of combat power estimation is focused on historical trends, doctrine, and the expected results of the use of the models. Consistent with George's explication of the methodology, a series of general questions were posed to each model. These questions guided and standardized data collection, thereby making systematic comparison and the accumulation of the findings of the case studies possible. Table 1 depicts the questions and the evaluation criteria that define the answers to them.

Table 1. Questions and criteria for applying Structured, Focused Comparison

#	Question	Criteria		
		poor	moderate	strong
1.	How well does the model represent numerical preponderance?	The model does not represent preponderance.	The model partially represents preponderance.	The model fully represents preponderance.
2.	How well does the model represent technology?	The model does not represent technology.	The model partially represents technology.	The model fully represents technology.
3.	How well does the model represent force employment?	The model does not represent force employment.	The model partially represents force employment.	The model fully represents force employment.
4.	How well does the model reflect the elements of combat power (CP) as described in ADRP 3-0?	The model does not include the elements of CP.	The model partially includes the elements of CP.	The model fully includes the elements of CP.
5.	How well does the model reflect the dynamic between the elements of CP described in ADRP 3-0?	The model does not represent the dynamic.	The model partially or unclearly represents the dynamic.	The model clearly and precisely represents the dynamic.
6.	How well does the model reflect the dynamic between numerical preponderance, technology, and force employment?	The model does not represent the dynamic.	The model partially represents the dynamic. It does not include all three categories, or the correlation is ambiguous.	The model fully represents the dynamic. The correlation between the categories is clear.
7.	Is the proposed equation (result) easily applicable in practice?	No, it presents a significant challenge for practical application.	Yes, but the overall result remains ambiguous.	Yes, its variables and their values are precise and the result renders clear comparison of CP.

Source: Created by author.

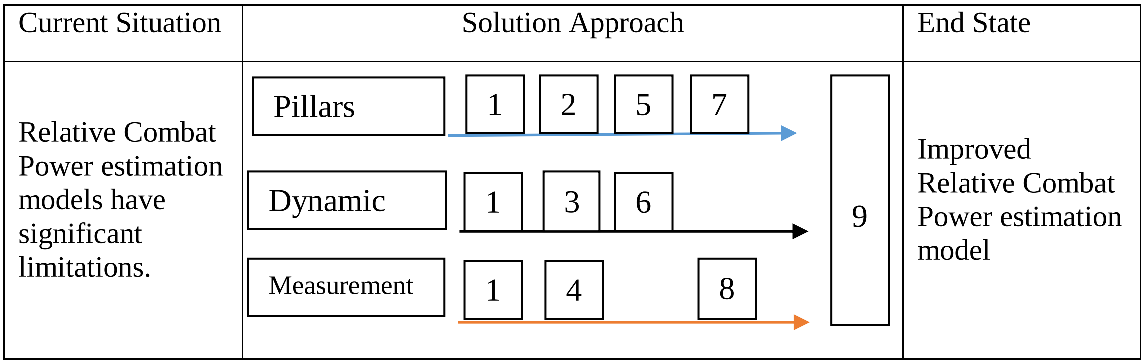
In the analysis chapter, the author applied the same questions to all three models. Measurable, although to a great extent subjective, criteria were developed to determine the degree (poor, moderate, strong) to which the models answer the questions. . The criterion “partially” means that the model answers the question in part, or addresses the issues only to a limited extend. In such a case, the model was evaluated as “moderate” for the asked question. Likewise, “fully,” i.e. a characterization of strong on a given question, means the model must completely satisfy all the possible elements of the answer.

Army Design Methodology

The U.S. doctrine describes Army design methodology as “an iterative process of understanding and problem framing that uses elements of operational art to conceive and construct an operational approach to solve identified problems.”[24] The author adapted this methodology to understand, visualize, and describe the thesis problem and to create an approach for answering the thesis question.

The current study followed the logic of ADP 5-0, *The Operations Process* and applied critical and creative thinking by exploiting the results of literature review and the structured, focused comparison of three models of combat power estimation. The author thereby created an understanding of the problem, developed an approach to answering the thesis questions, and, to use the terminology of the Army Design Methodology, reached the desired end state. The Army Design Methodology contributed to the study by providing logical framework for finding a solution to the proposed problem by filling the specified gaps, which emerged during the process of structured, focused comparison. Figure 2 depicts the logic flow for the use of the Army Design Methodology to arrive at a solution, i.e. a proposed model for relative combat power estimation.

[24]Headquarters, Departments of the Army, ADP 5-0, 7.



1 – Define the identified gaps.

2 – Determine the influence of identified gaps on the overall outcome.

3 – Determine the internal and external dynamic of WfFs and technology.

4 – Determine how to measure technology.

5 – Address the identified gaps.

6 – Determine the dynamic between the three pillars.

7 – Determine and explain force employment.

8 – Determine how to measure force employment.

9 – Develop a simple mathematical equation.

Figure 2. The logic flow for finding the solution

Source: Created by author.

The meaning of figure 2 depicts the author's logic flow for finding arriving at a solution to the proposed main research question. It shows the current situation, in which the existing models of relative combat power estimation have limited utility. The desired end–the answer to the research question–is an improved relative combat power estimation model. Thus the analysis is framed in terms of how the apply analysis to take the problem from its current situation to the desired end state. The analytical approach to the desired end state is depicted in figure 2 under the column labeled Solution Approach.

The solution should be achieved through analysis of three main areas, which are depicted by the horizontal rectangular boxes: pillars, dynamic, and measurement. The numbered square boxes place in sequence the main tasks of the analysis: define the identified gaps, explore the influence of those gaps on the relative combat power estimation process, determine the internal and external dynamic, and determine how to measure some of the relative combat power elements. The completion of the analytical tasks numbered from 1 to 8 led to task 9, which is depicted in the vertical rectangular box, develop a simple mathematical equation that mitigates or eliminates the limitations of the current situation. Thus, this process was framed and oriented towards the achievement of the desired end state.

The measurement of various elements of combat power and its relative estimation is a key aspect of the problem this research aims to address. Chapters 1 and 2 revealed significant obstacles in this area. The literature review, for example, presented force employment as an intangible variable. To at least partially resolve this problem, the current study draws on several historical examples to explain the author's view of the importance of WfFs balance for determining and eventually measuring the factor of force employment. The selection of the examples was based on the following criteria. First, the examples should clearly show the difference in effectiveness of a superior warfighting system, which uses different WfFs balance. Second, they should represent different time periods in history. Third, they should represent different states' armies. Finally, the examples should clearly show that the force employment was the major factor behind victory. Based on these criteria, the following historical examples are included in this study: the Bulgarian Army's "Odrin" offensive operation of 1913, the German Army's

Operation "Michael" of 1918, the artillery fortresses during the reign of French King Louis XIV, Napoleon's Grand Armée, the use of railroad networks during the American Civil War and WW I, and the German Army's "Blitzkrieg" operations in World War II. The purpose of using historical examples is to explain the author's logic in respect to the force employment; in particular the study relates them to a way for measuring force employment.

Risk

In designing the research, the author of this paper accepted risk in analyzing force employment. This was necessary due to the lack of a clear and precise definition of the correlation between numerical preponderance, technology, and force employment. Furthermore, a variable based on employment in the extant literature and methodologies for relative combat power estimation is defined as intangible. Thus the proposed solution needed a hypothesis that deviates from the term "modern system" and its use in practice. As a result the study addressed the problem from the point of WfFs balance. The analysis chapter introduces a hypothesis for the importance of WfFs and their role in the warfighting systems. The author's hypothesis suggests a way to use the elements of combat power in measuring technology and force employment. It is not validated and needs further research. The second vulnerable point was the measurement of force employment. The current study uses the results of Biddle's analysis, although Biddle reached his results by incorporating the "modern system" concept as a major part of his analysis. This risk notwithstanding, the current study draws on his work because the proposed hypothesis, based on WfFs balance and its influence, is applicable for the historical examples Biddle used in his own research. The author understood this risk and addressed it as an area that needed further research.

Summary

Chapter 3 provided information on the research methodology used in the paper. It highlighted three methods that were used to answer the primary research question. It explained the overall correlation between the literature review and the methods that enabled a critical and creative approach to the problem. The research methodology chapter described the analytical framework used by the author and provided the criteria employed in the analysis. Finally a risk assessment was provided in order to show the areas where further research is needed. This provided a solid analytical structure for chapter 4.

CHAPTER 4

ANALYSIS

> We cannot solve our problems with the same thinking we used when we created them.
>
> — Albert Einstein

The purpose of this chapter is to present the author's analysis, which supports the need for a new comprehensive approach to relative combat power estimation, and, based on that analysis, to propose improvements to existing models. The analysis chapter is structured in accordance with the methodology set out in chapter 3. Chapter 4 used the Ends, Ways, Means model to control the data set and the logic flow of the analysis provided in it. The means in this study are historical trends, the doctrinal meaning of combat power and the essence (pillars) of relative combat power. The ways are two analytical models that drew on the means. The author adapted the methodology of structured, focused comparison to analyze extant models of combat power estimation with the aim of identifing gaps or discrepancies in how the models approach relative combat power estimation. Three models for force ratio comparison are critically reviewed. The chapter examines the elements of combat power according their correlation and interaction with the factors of numerical preponderance, technology, and force employment. The author identifies some gaps in the models when exploiting all of the combat power elements. The results of the structured, focused comparison frame the research problem for the application of the second analytical approach, the US Army Design Methodology.

The author adapted this methodology to understand, visualize, and describe the thesis problem and to create an approach for answering the thesis question.

The study addresses the gaps identified in the structured, focused comparison. The aim of the analysis is to propose a way to quantify variables commonly accepted as intangible. Historical examples support explanations of several new definitions used in the research. The examples also support the explanation of the author's idea for the WfFs balance and its influence on combat power. The proposed value range for some aspects of force employment is based on the results of research done by Stephen Biddle. The interaction between the elements of combat power is consecutively analyzed. Finally, this study proposes a simple mathematical equation in a, step-by-step approach, as the final product of this analysis. The proposed model addresses the gaps indeitified in the Ends, Ways, Means analysis and represents the logic of the author. Thus the Ends,'" i.e. the improvement in relative combat power estimation are reached by including the three pillars: numerical preponderance, technology, and force employment.

Combat Power in Doctrine

U.S. doctrine, publications, and manuals clearly define and thoroughly describe combat power. It is defined as: "The total means of destructive, constructive, and information capabilities that a military unit or formation can apply at a given time."[25] Doctrinally, combat power has eight elements: leadership, information, mission command, movement and maneuver, intelligence, fires, sustainment, and protection. The

[25]Headquarters, Departments of the Army, ADRP 3-0, 3-1.

Army collectively describes the last six elements as the warfighting functions.[26] ADRP 3-0, *Unified Land Operations* relates the term combat power to Army core competencies, the tenets of unified land operations, the operations process, and the operational framework. A thorough understanding of combat power is mandatory for any practitioner of military art and science.

Relative Combat Power

The nature of the problem the current study seeks to address is the difficulty with or inability to adequately measure relative combat power. The elements that comprise it are broad and include vast numbers of variables. In addition, the relative nature of combat power is predetermined by its situational character. Wass de Czege describes its essence in the following way: "It has meaning only in relative sense – relative to that of the enemy–and has meaning only at the time and place where battle outcomes are determined. Prior to battle there exists only capability."[27] This short and concise statement drives three conclusions. First, the real combat power value is displayed only when it is exercised during battle. Second, the number of conditions and variables can never be the same. Third, prior to the battle, only capabilities can be measured.

In chapters 1 and 2 the author discussed some of most influential military theorists in the field, their main ideas and a few works that explain these ideas. This review showed that capabilities that should be considered belong to three categories: numerical preponderance, technology, and force employment. These categories are

[26]Ibid.

[27]Wass de Czege, 7.

collectively identified in the current study as pillars of relative combat power. Numerical preponderance refers to a quantitative imbalance between two opponents. It is usually displayed as a numerical ratio of people, weapon systems, units, or some combination of them. Technology is the category that assesses the imbalance in sophistication and capabilities of resources and systems that use them. The author argues that WfFs in their systemic meaning fall under this category. The last category is force employment, which refers to the way numerical preponderance and technology are used. It is an integral part of combat power and acts as its main multiplier.

The conclusion derived from this brief analysis is that improvements in accuracy of relative combat power estimation models should include or at least address all three of the aforementioned pillars – numerical preponderance, technology, and force employment. An equation for relative combat power estimation should look like the following:

$$(N_F \text{ x } T_F \text{ x } F_F):(N_e \text{ x } T_e \text{ x } F_e)$$

Where: N_F – Numbers of friendly forces;

T_F – Friendly technology factor;

F_F – Friendly force employment factor;

Ne – Numbers of enemy forces;

T_e – Enemy technology factor;

F_e – Enemy force employment factor.

Thus the foundations for follow on analysis are set by the historical trends, doctrine, and relative combat power pillars. A simple mathematical equation, which represents the ratio of the three combat power pillars between two opposing forces, is the foundation for further analysis that will lead In the following critical review the author discussed the degree to which these three pillars were incorporated in the presented models.

Structured, Focused Comparison of Existing Models of Relative Combat Power Estimation

Armies use models for relative combat power estimation in an attempt to predict the outcome of battles. A thousand of years military experience demonstrate that the ability to mass overwhelming combat power in time and space has been the key to victory. Based on that experience, U.S. Army doctrine has come to accept a set of historically-determined force ratios (table 2). These ratios accept correlational values of forces that are sufficient to successfully complete a mission. For the purpose of this study the author assumed that the following historical ratios (table 2) correctly satisfy relative combat power massing requirements of the various missions:

Table 2. Historical Force Ratio

Force Ratio (friendly : enemy)	Typical Mission
1:6	Delay
1:3	Defend (prepared)
1:2.5	Defend (hasty)
2.5:1	Attack (hasty position)
3:1	Attack (prepared position)
1:1	Counterattack (flank)

Source: Headquarters, Department of the Army, FM 34-130, *Intelligence Preparation of the Battlefield* (Washington, DC: Government Printing Office, 199), B-38.

The author also assumed that a commander and his staff will achieve victory if they correctly estimate the relevant ratios. Otherwise, if a miscalculation in combat power ratio is made, the commander will not be able to allocate enough resources. In that case the commander will suffer defeat. In this section of the analysis the author is focused on the degree to which different models exploit the three pillars of relative combat power. The purpose is to clarify the gaps in the existing models and to render the reader an opportunity and tool to make his/her own conclusions about the reliability of thesemodels. The following analysis of the three models of relative combat power estimation employs structured, focused comparison using the seven question presented in chapter 3, table 1.

Doctrinal Model

U.S. Army FM 34-130 *Intelligence Preparation of the Battlefield* (1994) provides a good, doctrinally based example of the process of relative combat power estimation. It includes several simple steps.

First, the planner needs to conduct a straight comparison of the number of units for friendly and enemy forces. The units should be at the same or equivalent organizational level. For illustrative purposes, FM 34-130 uses an example of 27 threat battalions opposed by 9 friendly battalions. The stratight-up force ratio in this case is 3:1 favoring the enemy.

Second, the actual number of units should be converted into “unit equivalents.” FM 34-130 uses “US equivalents.” This represnettaion takes into account the units’ size difference. Any opposing unit receives a value represented in terms of an analytically-based assessment of it in comparison to a US unit equivalent. In the cited case, the opposing battalion received a value of 0.6 US equivalent battalions. Continuing with the calculation of relative force ratio, the total number of units is multiplied by the unit equivalent (27x0.6=16.2). Now the ratio of enemy to friendly units is 16:9 or 1.8:1 (down from 3:1).

The ratio is further refined by accounting for the difference in combat capability of the type of equipment in each unit. Usually an army possesses a methodology to assign values for the capabilities of various weapons systems. In the illustrative example, US battalions are equipped with M1tanks and opposing battalions with T-55s. The value of the M1’s combat power compared to the T-55’s is 2:1. The ratio is thereby recalculated as 16x1:9x2=16:18 or 1:1.1, now in favor of the friendly force.

This simple example demonstrates the doctrinal method that is used to assess relative combat power. However, the same page of FM 34-130 also includes an important caveat: "Assigning these values requires careful judgment of the relative capabilities of the equipment involved. Be careful to avoid letting wishful thinking cloud your judgment. You should also resist the temptation to attempt to account for other, less tangible factors such as leadership and flexibility."[28]

Although this model fully represents numerical preponderance, it suffers from some shortfalls. It considers the total number of units and weapon systems on both sides. The method also takes into account to some degree technology. It incorporates a model to estimate the relative combat power of weapon systems, for example main battle tanks. However, it does not render a full comparison of all the technology that opponents use. An example is communication systems available to the two sides. The model does not take into account force employment at all, neither does it include all the elements of combat power described in US ADRP 3-0. Counting the tanks and artillery systems and their relative weight refers to two WfFs, movement and maneuver and fires. Furthermore, it refers not to the WfFs themselves, but to the capabilities that they represent on the battlefield. Thus the model represents two of eight doctrinally determined elements of combat power. As for the dynamic between the elements of combat power, in this model there are only two of the elements and they are in direct ratio. As the imbalance in technological capabilities of the WfFs increases, so also does the imbalance in force to force ratio. Thus the imbalance in movement and maneuver and fires multiplies the

[28]Headquarters, Departments of the Army, FM 3-130, *Intelligence Preparation of the Battlefield* (Washington, DC: Government Printing Office, 1994), B-38.

numbers. The model does not fully represent the dynamic between numerical preponderance, technology, and force employment. It does not even include all three categories. Force employment is not part of this model and technology is represented only by the capabilities of movement and maneuver and fires. These shortcomings – identified through structured, focused comparison - notwithstanding, the method used in the example is simple and produces an understandable result. The quantifiable ratio of 1:1.1 is clear and may be easily used in planning along with the Historical Force Ratio (figure 3) for specific missions. Thus it supports the commander in decision making and allocating his resources.

Wass de Czege's Model

In his work *Understanding and Developing Combat Power* (1984) BG (Retired) Wass de Czege describes the logic of his model through the prism of leadership and the capabilities that leaders possess. He stresses the effects of three basic capabilities: firepower, protection, and maneuver. The forth variable for him is combat leadership. He describes its effect as follows: "The actions which leaders take either increase or decrease their own capabilities or those of the enemy in some way."[29] Wass de Czege depicts the logic of his model as a mathematical equation.

$L_F(F_F+M_F+P_F-D_E) – L_e(F_e+M_e+P_e-D_F)$ = The Outcome of Battle[30]

Where:

L_F – friendly leadership effect; L_e – enemy leadership effect;

[29]Wass de Czege, 9.

[30]Ibid., 10.

F_F – friendly firepower effect; F_e – enemy firepower effect;

M_F – friendly maneuver effect; M_e – enemy maneuver effect;

P_F – friendly protection effect; P_e – enemy protection effect;

D_e – enemy degrading of friendly firepower, maneuver, and protection effects;

D_F – friendly degrading of enemy firepower, maneuver, and protection effects;

It looks like a simple equation, but each of the elements that comprise it is a complex function of many variables. If these variables are viewed in terms of current US Army doctrine, it becomes clear that Wass de Czege advocates the incorporation of the elements of combat power into an equation. To add to the complexity of his calculation, he determines three levels of abstractions. The four variables (leadership, firepower, movement and protection) constitute just the first one. Any of the four variables is determined by a set of 18 sub-variables, and these are again determined by about 64 more specific variables.

Wass de Czege's model, while comprehensive in its abstraction and on the surface more developed than the model in FM 34-130, also has its downsides. In the assigned variables he addresses numerical preponderance, technology, and even partially force employment. However, the variables and sub-variables are so many, and some of them are situationally dependent. That makes the use of the model too complicated. Furthermore, he states, "Certain aspects of each of those terms are quantifiable, but many aspects ultimately might not be."[31] The equation does not provide a clear correlation between three of the four major effects that he describes. It is not sufficiently clear why the effects of firepower, maneuver, protection, and degradation should be summed. On

[31]Ibid., 10.

the other hand, the effect of leadership multiplies the sum of the other four effects. As a result the only factor that relates to everything else is the de facto intangible one - leadership.

As the application of structured, focused comparison reveals, Wass de Czege's model fully represents preponderance. It also makes an effort to represent technology in full scale, while it partially considers tactical employment,[32] and training.[33] Both are part of force employment. This model fully includes the elements of combat power or their equivalents as they existed in doctrine in 1984. However, the dynamic between these elements is unclear. Wass de Czege stated that the elements should be considered, but he also agreed that some of them are intangible. His model also partially represents the dynamic between preponderance, technology, and force employment. Furthermore, the correlation between them remains ambiguous. As a result, Wass de Czege's model represents a significant challenge for practical application. His equation possesses a logic that responds to current US doctrine, but is too complicated in its full rendering. At the same time, it needs a relative quantifiable leadership variable in order to be applicable.

Barham's Analysis–Relative Combt Power Matrix

Brian Barham, in his monograph *What is Relative about Combat Power?* agrees that the doctrinal force-to-force ratio does a good job incorporating maneuver and firepower into the equation that determines relative combat power. He also notes that numerical relative force ratios do not factor in what the current study terms force

[32]Ibid., 12.

[33]Ibid., 15 and 39.

employment, or the human factor.[34] He suggests that a relative combat power matrix may support the commander and staff in decision making. He also offers an analytical model for subjective assessment of the results presented in the matrix, which is adapted below to include the WfFs (table 3).[35]

Table 3. Relative Combat Power Matrix with WfFs

	Friendly Forces	Enemy
Movement and Maneuver	Strengths / Weaknesses	Strengths / Weaknesses
Fires	Strengths / Weaknesses	Strengths / Weaknesses
Intelligence	Strengths / Weaknesses	Strengths / Weaknesses
Protection	Strengths / Weaknesses	Strengths / Weaknesses
Sustainment	Strengths / Weaknesses	Strengths / Weaknesses
Mission Command	Strengths / Weaknesses	Strengths / Weaknesses

Source: Created by author.

He derives conclusions for the significant factors of battle by examining the elements of combat power in accordance with the operational environment. In this way, the planner supports decision and COA development. Barham does not propose a different model, but an addition to the existing one. In his conclusion he points out the insufficiency of the doctrinal model. However, he recommends the planner concentrate

[34]Barham, 14-15.

[35]Barham's monograph pre-dates the introduction of the concept of warfighting functions into Army doctrine.

on the elements of combat power.[36] That should be accomplished by using the relative combat power matrix. Consistent with Barham, one can conclude that a planner should address the relative weight of the WfFs. This method of thinking is an attempt to support the doctrinal model presented in the study, by incorporating WfFs or their relative capabilities.

Barham's model does not reflect a change from the doctrinal model as regards numerical preponderance due. The Relative Combat Power Matrix (Figure 4), as adapted by the current study, represents technology through a subjective assessment of the relative capabilities of WfFs. It encompasses all of them, but it does not explain or propose suggestions about how to translate into the equation. So, in fact, it only partially represents technology. This model does not include force employment. Finally, the model does not present any significant improvements in exploring the dynamic between preponderance, technology, and force employment. The matrix is easy to use but its practical application remains subject to question. The "so what" question remains unanswered. As a result, it may provoke uncertainty instead of providing help in the planning process. However, a skillful commander or planner will be able to see opportunities instead weaknesses.

[36]Barham, 46.

Summary of Structured, Focused Comparison

The questions and the evaluation criteria for the comparison of these models were shown in Table 1. The results from "Structured, Focused Comparison" of these three models for relative combat power estimation are presented in table 4

Table 4. Comparison of the models

	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7
Doctrinal Model	Strong	Moderate	Poor	Moderate	Moderate	Moderate	Strong
Wass de Czege's Model	Strong	Strong	Moderate	Strong	Moderate	Moderate	Poor
Relative Combat Power Matrix	Strong	Moderate	Poor	Moderate	Moderate	Moderate	Strong

Source: Created by author.

The structured, focused comparison strongly suggests that the three models have limitations. The doctrinal method that was used in practice and the Relative Combat Power Matrix that is still used in MDMP are strong only in two of seven criteria: simplicity and accounting for numerical preponderance. This result is attaributable to the fact that in each case the equation is clear and easy to apply to the planning process. The comparison also shows that these two methods do not take into account force employment. Four of the criteria (questions 2, 4, 5, and 6) were assessed as moderate, which means that the elements of combat power, the dynamic between these elements, and the dynamic between the relative combat power pillars is partially taken under consideration. Wass de Czege's model was assessed strong in three criteria and moderate in three others. In spite of that, its use in practice remains problematic as it was assessed poor in question 7, practical application. Although Wass de Czege's model is closer to the logic of current US doctrine, the equation is complicated. Furthermore, multiplying all variables by leadership degrades its usefullness because, as Wass de Czege himself acknowledges, this factor is intangible and therefore not measurable.[37]

Army Design Methodology: Solving the Problem

Structured, focused comparison revealed gaps in all lines of effort of the application of the Army design methodology as depicted in figure 2, chapter 3–pillars, dynamic, and measurement. The three pillars of relative combat power estimation–preponderance, technology, and force employment - were derived from the key works in literature review. Table 4 shows that only numerical preponderance is fully represented in the models. Technology and force employment are partially or poorly taken under the consideration. This is a significant gap in two of the three pillars. The existing gap in this line of effort raises serious questions about the reliability of results derived from the models. The second line of effort, dynamic, suffers from significant gaps, too. The three models compared in thie current study partially address the internal dynamic of the combat power pillars. This assessment is especially valid for technology and force employment. The study assumed that the WfFs represent the level of technology in their

[37]Wass de Czege, 7.

areas (chapter 1, assumption 3). The comparison of the models reveals that the elements of combat power–WfFs plus leadership and information, are partially included, or the correlation among them is unclear and ambiguous. Furthermore, the dynamic between preponderance, technology, and force employment–Question 6 in the structured, focused comparison - was evaluated as moderate. Overall, the internal and external correlations of the pillars are missing or ambiguous. Thus, the gaps in the dynamic line of effort call into question the reliability of results generated from these models.

The gaps in the measurement line of effort of the application of the Army design methodology became clear after the structured, focused comparison. All models present their result as a mathematical equation. However, the doctrinal (FM 34-130) model and the Relative Combat Power Matrix, as an addition to it, measure fully the pillar of numerical preponderance and partially the pillar of technology. These two models do not measure force employment, and do not measure four of the six WfFs. Wass de Czege's model is an attempt to incorporate all combat power elements by assigning variables for all of them; yet it fails to quantify the variables. Wass de Czege multiplies everything by leadership, an intangible and hitherto unquantifiable factor. The effect of gaps in measurement is the impression that all the models are significantly limited in their utility.

This part of the analysis strives to propose a new model that addresses the identified gaps. Relative combat power estimation should consider the three pillars of numerical preponderance, technology, and force employment. It should also consider the correlation between them in terms of capabilities and effects that they produce.

Numerical preponderance is the most quantitative of the three pillars. It presents the imbalance in personnel strength and/or numbers of different weapon systems that a military force possesses. It may be calculated in numbers of units, for example the number of battalions, brigades, or divisions. It is easy to display and understand. To derive the numerical imbalance the planner can simply compare the strength of two opponents. It is a necessary, but not sufficient factor for estimating combat power. However, it is related to all elements of relative combat power as it measures their quantity. Numerical preponderance is the foundation on which total combat power is built.

Technology is the second factor that influences relative combat power estimation. Similar to numerical preponderance, it is a necessary, but not sufficient factor. There are two approaches to the role of this factor: systemic and dyadic. Systemic is focused on the gross "state of the art" in the international system at any given time, rather than the particulars of individual states' holdings.[38] This approach is best represented in Offense-Defense theory. The second approach holds that technology's effects are mainly dyadic, not systemic: "if A enjoys technological edge over B, then A prevails – whether A attacks or defends. Whereas systemic technology theorists see technology as favoring attack or defense across the international system, dyadic theorists see its chief effect as favoring individual states over others, depending on their particular holdings."[39] These theories represent different approaches to the problem. They stress the importance of technology and suggest it as main factor for victory in modern battles. Still neither of them neglects the role of numerical preponderance.

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[38]Stephen Biddle, *Military Power: Explaining Victory and Defeat in Modern Battle* (Princeton: Princeton University Press, 2004), 15.

[39]Ibid., 16.

The Warfighting Functions: A Tool for Advancing Relative Combat Power Estimation

The US Army's WfFs offer significant leverage in advancing the utility of models of relative combat power estimation. In this study the author assumed that the WfFs represent the capabilities of technology in their respective areas. The author also argues that the technological capabilities of WfFs are tangible and comparable. The three extant models examined in this thesis included in full numerical imbalance.

The doctrinal (FM 34-130) is the starting point for integrating the WfFs into the process. This model incorporates the capabilities of movement and maneuver and fires. The technological capabilities of these two WfFs are bound to the numbers of weapon systems. That represents two of the eight elements of combat power. As noted earlier in this analysis, the notional example taken from FM 34-130 resulted in a 1.1:1 force-to-force ratio, in favor of US forces against opposing forces. To add the effects of the other WfFs the planner should understand their dynamic, in terms of enabling or multiplying their effects. Movement and maneuver and fires are WfFs that produce the lethal and destructive effects of combat power. The other four WfFs - intelligence, protection, sustainment and mission command - either enable these effects or multiply them. Some of them may simultaneously enable and multiply the lethal and destructive effects. The planner should clarify for each WfF whether it is an enabler or multiplier. This is important as, in the study, enablers are evaluated by measuring performance, and the multipliers are evaluated by measuring effectiveness.

The mechanics of integrating the WfFs into the estimation of relative combat power begin with the Relative Combat Power Matrix starting point. Having it in hand, the planner should determine the effects of the capabilities of WfFs and incorporate them into the equation of the force-to force-ratio. The analysis performed earlier in this chapter shows that the doctrinal model fully represents friendly numbers (N_f) and enemy numbers (N_e) in the following equation (N_F x T_F x F_F):(N_e x T_e x F_e). It incorporates the technology of movement and maneuver and fires. The effects of the movement and maneuver WfF and fires WfF had a multiplicative effect in the notional example taken from FM 34-130. The variables for friendly and enemy technology T_f and T_e should include the remaining WfFs or the relative effects of their capabilities. Thus the components of T_f and T_e are the WfFs sustainment, intelligence, protection, and mission command. The other technology variables should be incorporated in the doctrinal equation. Their effects should be multiplicative, like the effects of the movement and maneuver and fires WfFs in doctrinal model. In other words T_f = (S_f x I_f x P_f x M_f). Likewise T_e = (S_e x I_e x P_e x M_e), where:

S_f – The effect of the capabilities of the friendly sustainment WfF to fully execute its mission in percentage;

S_e – The effect of the capabilities of the enemy sustainment WfF to fully execute its mission in percentage;

I_f – The effect of friendly intelligence WfF capabilities;

I_e – The effect of enemy intelligence WfF capabilities;

|P_f – The degree of which the friendly protection WfF meets the enabling requirements;

P_e – The degree of which the enemy protection WfF meets the enabling requirements;

M_f – The degree to which friendly forces are capable of using command and control systems in order to execute the art of command and the science of control;

M_e - The degree to which enemy forces are capable of using command and control systems in order to execute the art of command and the science of control;

WfFs and their capabilities create effects on the battlefield. This study measures the expected effects that WfFs may create. In order to measure these effects and to assign them quantifiable values the author divided the capabilities of WfFs into two groups: enablers and multipliers. The enablers are the sustainment, protection, and mission command WfFs. The multipliers are the intelligence, mission command, and protection WfFs. Two of the WfFs may fit into both categories, as will be further discussed. For explanatory purposes, the current study assigned illustrative values to the different WfFs.

The sustainment WfF is an enabler. It enables the other WfFs to execute their role in a combined arms fight. If sustainment is functioning at 100 percent it will ensure the full capacity for lethal and destructive effects. The full capacity of the movement and maneuver and fires WfFs is already part of the equation. That means that sustainment value ranges from 0 to 1, as it may enable or restrict this capacity. When sustainment is incorporated in the equation, a planner should take under consideration that enablers influence only their own forces. So the effects, which friendly and enemy sustainment capabilities create, should multiply both sides of the force-to-force ratio equation. The result will be their weight in relative combat power estimation. The assigned value is subjective, but it should be based on the expected effects of the sustainment WfF's anticipated performance. It represents the planner's evaluation of the possible constraints that sustainment may exercise on the mission if this WfF suffered some losses.

Intelligence is a multiplier of the lethal and destructive effects. Superiority in it directly influences enemy capabilities. Multipliers or their value apply only to one side of the equation. In the case of intelligence, the planner should determine the relative imbalance in the intelligence WfF. This relative imbalance should be based on the effects that both sides' intelligence system capabilities may produce. A way to calculate this imbalance would be to compare both opponents' intelligence capabilities in terms of space, time, target acquisition and surveillance.

Protection is a WfF that may be an enabler and multiplier at the same time. It is an enabler when it fulfils the requirements of cover, concealment, and reducing the exposure of the force to enemy effects. In this case it value ranges from 0 to 1. The multiplying effect is the effect that directly influences the opposing force's combat power. When such a factor exists, it should be determined what element of opposing combat power suffers from this effect to what degree it suffers. An example for such a factor may be an obstacle placed upon an avenue of approach. The assessed effect or effects of the introduction of this factor will proportionately reduce the value of the affected WfF(s).

The mission command WfF as it is defined in Army doctrine is an enabler and multiplier to the combat power. However, there are some differences in the way that it should be analyzed as compared to protection. Mission command encompasses three complementary parts: command and control system, the art of command, and the science of control.[40] In this study the command and control part of this WfF is related to technological capabilities. The art of command and the science of control are related to force employment and they will be discussed later. Thus the command and control system could be measured in the same way as the other enablers, through a performance

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[40]Headquarters, Departments of the Army, ADP 6-0, *Mission Command* (Washington, DC: Government Printing Office, 2012), 9.

measurement. This capability is determined by the degree to which commanders are able to use information systems, networks, facilities and equipment to execute their authority. The value of command and control thus belongs in the range from 0 to 1. In the most preferable case the friendly forces will possess the capability to communicate through their chain of command without restrictions. In that case the value will be 1. However, in modern warfare both sides will be capable of reducing this capability to some degree. Based on the relative combat matrix analysis the planner should determine degrading capabilities and apply their expected effects into the equation. The value of mission command may be reduced by an opponent's degradation capabilities. The degree to which this will be reduced is the result of subjective judgment, based on anticipated degrading effects caused by the enemy. If that is the case, the reduction should be measured as a percentage. Thus overall the mission command ranges between 0 and 1 and is incorporated to both sides of the equation as a multiplicative effect.

The mathematical representation of the logic for calculating the effects of the WfFs is depicted in the following example that includes a measurement of technology. The relative combat power estimation equation should include the three pillars. This is mathematically represented as:

$(N_F \text{ x } T_F \text{ x } F_F):(N_e \text{ x } T_e \text{ x } F_e)$

or (with the addition to the model of a measurement of T, technology)

$[N_F \text{ x } (S_f \text{ x } I_f \text{ x } P_f \text{ x } M_f) \text{ x } F_F]:[N_e \text{ x } (S_e \text{ x } I_e \text{ x } P_e \text{ x } M_e) \text{ x } F_e]$, where:

N_F – Numbers of friendly forces;

T_F – Friendly technology factor;

F_F – Friendly force employment factor;

Ne – Numbers of enemy forces;

T_e – Enemy technology factor;

F_e – Enemy force employment factor.

S_f – The effect of the capabilities of the friendly sustainment WfF to fully execute its mission in percentage;

S_e – The effect of the capabilities of the enemy sustainment WfF to fully execute its mission in percentage;

I_f – The effect of friendly intelligence WfF capabilities;

I_e – The effect of enemy intelligence WfF capabilities;

P_f – The degree of which the friendly protection WfF meets the enabling requirements;

P_e – The degree of which the enemy protection WfF meets the enabling requirements;

M_f – The degree to which friendly forces are capable of using command and control systems in order to execute the art of command and the science of control;

M_e - The degree to which enemy forces are capable of using command and control systems in order to execute the art of command and the science of control;

Turning to the notional example from the doctrinal model, which the current study has expanded upon, where numerical preponderance and the technology of movement and maneuver and fires (the WfFs in existence at the time of the pbulicaiton of the example, although not under the name "warfighting function"), were fully represented in ratio 1.1:1 favoring friendly forces. Let us assume that after analysis of the relative effects of the WfFs on the opposing forces, the planner reached the following conclusions (all numbers are illustrative):

Sustainment: The friendly forces' sustainment WfF is fully operational but the enemy's sustainment WfF was partially destroyed. The destruction will reduce the enemy's capabilities by at least 5 percent. Therefore, $S_f = 1$ and $S_e = 0.95$;

Intelligence: The friendly forces' intelligence WfF capabilities exceed the enemy's capabilities in such a way that it will give friendly forces a 10 percent multiplicative effect on their lethal and nonlethal effects. The value for the intelligence variable will be $I = 1.1$ and it should be incorporated as a multiplier on the friendly forces side of the equation only.

Protection: The friendly forces are capable of using cover, concealment and to reduce their exposure; however the enemy protection WfF is assessed weaker in comparison to the friendly one due to the advantage in the friendly forces' intelligence WfF. is the planner assessesan increased enemy exposure to some friendly weapon systems that will create an effect of a 10 percent loss of enemy combat power. Thus the value for the protection WfF as an enabler will be $P_f = 1$ and $P_e = 0.9$. The same subjective evaluation of the capabilities of both opponents applies to protection as a multiplier, too. Assuming that the enemy is capable of creating some terrain obstacles and its capabilities are assessed to reduce friendly forces' freedom of maneuver by 5 percent, this degrading effect should be incorporated on the friendly side of the equation with a value equal to the assumed scale of the degrading effect, or $P_d = 0.95$.

Mission command: The technology effect of the mission command WfF is measured in this study as the capabilities that include the command and control system. The planner should apply the same standards for both opponents in this portion of the analysis. The assessment should consider not only the capabilities of the opponents to communicate and exercise command and control, but also the time that they need to do it. If the two systems are assessed as fully operational, then the value of their effects will be 1 or $M_f = 1$ and $M_e = 1$. The degrading effects should be considered simultaneously and the other factors that mission command influences should be adjusted to this effect. If the effects of degradation are equal for both sides then no change is needed. For this example the author assumed that the effects of friendly degradation will reduce the enemy command and control system by 5 percent. In that case $M_d = 0.95$. Thus the calculation of the equation with the addition of the technology factor is as follows:

$[N_F \text{ x } (S_f \text{ x } I \text{ x } P_f \text{ x } M_f \text{ x } P_d) \text{ x } F_F]:[N_e \text{ x } (S_e \text{ x } P_e \text{ x } M_e \text{ x } M_d) \text{ x } F_e]$

$[1.1 \text{ x } (1 \text{ x } 1.1 \text{ x } 1 \text{ x } 1 \text{ x } 0.95) \text{ x } F_F]:[1 \text{ x } (0.95 \text{ x } 0.9 \text{ x } 1 \text{ x } 0.95) \text{ x } F_e]$

$1.4 \text{ x } F_F : 1 \text{ x } F_e$

The result, which used illustrative numbers, took into account the technology factor. The example showed that prior to incorporating force employment, the final factor in the proposed model, the ratio became 1.4:1 favoring friendly forces. With the assigned values for the effects of technology the result presented a 27 percent increase in relative combat power in favor of the friendly force. This increase was neither part of the doctrinal model, nor was it reached after the analysis made with the Relative Combat Power Matrix. Measurement of the technology factor in such a way gives an answer to the “so what” question that appeared after the comparison of the WfFs. The analysis of capabilities and their effects is relative, and it needs experienced and professional planners and analysts capable to provide fair assessments regardless of their own wishes or desires. It represents a snapshot of the situation in time and space. It is fluid and changes with the progress of battle. Still, the force-to-force ratio that was reached is not the relative combat power ratio. The integration of force employment into the model will produce this ratio.

Force Employment

Force employment is the way commanders use their resources in peacetime and during campaigns, operations, battles, and engagements to achieve victory. Force employment may serve as a multiplier to combat power, or it may significantly degrade numerical and technological superiority. However, measurement of this important component has always been subjective and very ambiguous. This study presents a novel approach to force employment. The author examines the problem from the perspective of the levels where its effects are evident. The whole component is divided into two main parts. The first part is tactical force employment. The second one is operational force employment. These two categories are further divided into two subcategories: superior and similar force employment. The author argues that force employment could be distinguished and assigned to some of these categories and subcategories. This study used several historical examples to clarify that idea and to explain the way conclusions were derived.

Similar and Superior Tactical Force Employment

Tactical force employment is divided into two subcategories: similar and superior. Similar tactical force employment (STF) is the employment of forces in their doctrinally determined and standardized way. This force employment is tangible. It represents the capabilities of personnel to use the available technology systems. It also represents the ability of personnel to combine and direct the technology systems in their numerical quantity. This combined use of different systems is determined and standardized, so it can be measured by assessing the degree to which the personnel are ableto use the available systems. Any army possesses its own requirements and a methodology to evaluate them, such as training standards or requirements. The value assigned to STF should be based on the degree to which the force's personnel meet these requirements. This value is further discussed after the examination of the historical examples.

Superior tactical force employment (STF) is the employment of forces in a way that is new and unexpected for the opponent with an optimal use of new technology and capabilities. In other words, this is development and use of novel tactical solutions for existing problems. For illustrative purposes,, the author selected two examples. First example is the STF by the Bulgarian Army against forces of the Ottoman Empire during the Balkan wars, especially the "Odrin" Offensive Operation of 1913. The second example is operation "Michael"–The Second Battle of the Somme in 1918. This example explains German STF relative to the British Army.

In 1913 on the Balkan Peninsula, the Bulgarian Army led a coalition against the Ottoman Empire. After two years of war, most of the Ottoman forces were pushed out of Europe. The only major force that remained on the Balkan Peninsula was dislocated and encircled in the heavily fortified fortress of Odrin (Adrianople, Edirne). In January 1913 Ottoman forces launched a counter offensive with the strength of two armies and one independent army corps. After defeating the Ottoman counter offensive the Bulgarian High Command made a decision to seize the fortress of Odrin and to bring the war to an end. The Ottoman force's strength was 63,500 soldiers. The fortress artillery was comprised of 459 cannons of different calibers. The defense was built in three positions.

The forward defensive positions were built mainly from earth fortifications, the main defensive position was composed of 24 concrete forts, and the rear defensive position was comprised of earth fortifications. Anti-personnel ditches and mines supplemented the defense.[41] The Bulgarian Army led the coalition's strength that surrounded Odrin and consisted of around 153,000 men.[42] For the offensive, the Bulgarian army relied on 424 cannon, and 238 of them were concentrated on the breakthrough assigned sector.[43]

Most of the military specialists of that time believed that the fortress of Odrin could only be seized after a long lasting offense. On the 11th of March at 1330 the offensive started with two days of artillery preparation. On the March 12 after sunset, the Bulgarian infantry started its attack. Thirty hours later the Ottoman garrison commander was forced to surrender. As a comparison, in 1913, in Europe, only one fortress was comparable to the fortress of Odrin–the fortress of Verdun , France. During WW I the frontal attacks on the fortress of Verdun resulted in more than 300,000 killed and 400,000 wounded, with no success for the attacker.

The most plausible explanation for the victory achieved by the Bulgarian Army was force employment. The force-to-force ratio was 2.4:1 in personnel favoring the Bulgarian Army. The artillery ratio was 0.9:1 barely favoring the Ottoman forces. The

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[41]Nelko Nenov, "Conquering the Odrin Fortress in 1913–Great Victory of the Bulgarian Weapon," *Artillery Review* (Faculty of Artillery, Air Defense, and CIS, National Military University, Shumen, March 2007), 23.

[42]Nelko Nenov, "The Victory at Odrin–Triumph of the Bulgarian Artillery," *Artillery Review* (Faculty of Artillery, Air Defense, and CIS, National Military University, Shumen, April 2013), 26.

[43]Nenov, "Conquering the Odrin Fortress in 1913–Great Victory of the Bulgarian Weapon," 24.

imbalance in technology was not significant in 1913. The Ottomans had balloon and radio capability in order to maintain communication with Constantinople. The Bulgarian Army had several planes and also balloons. The core of the success, however, was found in several new tactical solutions used by the Bulgarians. First of all, the artillery was used differently. The purpose of artillery preparation was to conceal from the enemy the massing of forces in the breakthrough sector. Second the Bulgarian Army pioneered new artillery tactics, one of which later became known as “Feuerwalze,” and the second of which was the standing barrage. These two new artillery tactics were appliedthorugh uninterrupted artillery support of the infantry throughout the operation. For the first time fire correction was made from planes and balloons.[44] The infantry advance was made under the cover of artillery fire. As if to underscore the influence of force employment in this case, the very possibility to seize the fortress of Odrin was breached only thankstoGeneral Ivanov N. and Colonel Zhekov N, who only raised it based on their confidence in the ability of the Bulgarian Army to use the weapon systems in an optimal way.[45]

The second historical example that underlines the significance of superiority in tactical force employment is from 1918. Operation “Michael” is thoroughly discussed by Biddle in his book *Military Power: Explaining Victory and Defeat in Modern Battle*. The author of the current study uses some of his summarized data to provide the example: By 1918, the Western front of WW I had been in in a stalemate for more than three years. The United States entered the war on the April 2, 1917. The German submarine campaign

[44]Nenov, “The Victory at Odrin–Triumph of the Bulgarian Artillery,” 30.

[45]Ibid., 23.

against Britain had failed. For the Germans, it was obvious that they were going to meet the united forces of the US, France, and Great Britain. After the conclusion of the Treaty ofBresk-Litovsk, Germany was able to transfer more than 40 divisions from the east to the western front. Germany made the decision to end the war before the Americans arrived in force.[46] The German plan was to break through the allied lines, split the British and French armies, and to push the British to the Channel.[47] The British forces in the sector comprised of 31 divisions, against which the Germans concentrated 63 divisions.[48] This is a force to force ratio of 2:1 favoring the Germans.[49] The level of technology imbalance, the second main component of the combat power equation proposed in the current study, was again not significant. As Biddle observed, "The net result was a technology mix little different from that of the preceding three years of trench warfare."[50] The major difference between this offensive and the attacks that failed to break the stalemate was the use of "storm troopers" in an innovative way.[51] The Germans achieved tactical success and made the breakthrough. However, they proved incapable of exploiting the success.

These two examples show the importance of STF. It multiplied the combat power of the Bulgarian Army in the first example, and the German Army in the second one. In

[46]Biddle, 82.

[47]Ibid.

[48]Ibid., 87.

[49]Ibid.

[50]Ibid., 86.

[51]Ibid., 83.

both cases the attacking armies did not have the needed force-to-force ratio to achieve success. However, in both examples these armies had the needed combat power to achieve it. The value of STF that brought these two armies to the success will be discussed later in the study.

Superior Operational Force Employment (SOF)

Superiority in force employment is relative on both the tactical and operational levels. The author argues that superior operational force employment is determined by organizational structure. It depends on the arrangement of the WfFs balance. A situation in which two opponents have the same WfFs balance refers to similar operational force employment (SOF). In that case neither of the opponents possesses a structural or organizational advantage. Neither side has a superior warfighting system. A superior warfighting system is one that incorporates the contemporary achievements of science into force design and simultaneously adopts military doctrine to achieve optimal effects from the WfFs balance. The author argues that such a new and better WfFs balance could be achieved only by shifting the leading role among the WfFs (see chapter 1, definitions). Therefore SOF should be added to the equation for calculating relative combat power only when one of the opponents' structures represents a superior force employment system in relation to the other opponent's structure. The following examples were selected to clarify this idea.

A brief historical investigation suggests several examples for such a change over the last 400 years. The first example for a shift in the leading role among WfFs is in the protection WfF. The French King Louis XIV, influenced by Sebastien Vauban, started to build a “ring of fortresses girding the kingdom,”[52] thus signalling the rise of artillery fortresses. These massive emplacements allowed the defender to use their protection. The location of the fortresses ensured positions of relative superiority for the defending artillery. They also served as logistic hubs. Thus protection served as the most powerful enabler and multiplier for combat power of the defending force. In comparison, the attackers could not use the same protection effect. The conclusion of military theorists from that era was logical: defense is superior to offense.[53] The author argues that the force, which occupied an artillery fortress used a superior warfighting system compared to the force that attacked. This conclusion is based on a combination of force design and military strategy that utilized and was built upon the protection of fortresses.[54] The defenders in this example enjoyed relative operational force employment superiority due to the shift of protection WfF to the leading position among the WfFs.

The next example for a change in the leading role among the WfFs and establishing of new balance is the Grand Armée of Napoleon. Napoleon made a change by shifting the leading role to the contemporary equivalent of the command and control WfF. He utilized the existing technology of Chappe’s semaphore telegraph to improve his communications.[55] He also created a very flexible command and control system

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[52]Peter Paret, *Makers of Modern Strategy from Machiavelli to the Nuclear Age* (Princeton: Princeton University Press, 1986), 83.

[53]Clausewitz, 84.

[54]Paret, 74.

[55]Norman L. Durham, “The Command and Control of the Grand Armee: Napoleon as Organizational Designer”(Thesis, Naval Postgraduate School, Monterey, 2009), 2.

thorugh changes in the force design of his army. The development of the corps system was a game changer for the period. Napoleon used the available technology to support the structure of his new command and control system. The result was the capability to exercise control over a number of forces, in time and space, that was unthinkable before. Napoleon Bonaparte achieved a superior warfighting system compared to his opponents, which resulted in SOF. Napoleon's command and control system ensured superior maneuverability, speed and victories, some examples of which were the battles of Ulm 1805, Austerlitz 1805, Friedland 1807, Wagram 1809, and Dresden 1813. He retained this superiority until his opponents adjusted their systems to the same WfFs balance. When that happened the operational force employment became equal.

Third example involves the sustainment WfF. Supporting a huge army has historically been difficult. Sustainment was a constraint to the reach of operations until technology provided a solution. Trains and the railroad network became key components to the projection of military power. In the American Civil War the main lines of operations were determined by the railroad network. On the eve of WW I the European military mobilization and sustainment plans were designed to exploit the capabilities that the railroad provided. "European general staffs therefore produced elaborate plans to mobilize and deploy such reserves by railroad at the outbreak of war."[56] In contrast to the aforementioned examples of protection and command and control, the leading role of sustainment appears not in victories but in the inability to exploit success. This is obvious in the western front of WW I. The situation supported the defenders as they were capable

[56]Jonathan M. House, *Toward Combined Arms Warfare: A Survey of 20th-Century Tactics, Doctrine, and Organization* (Fort Leavenworth: Combat Studies Institute, 1984), 9.

easily to close of any limited penetration, and on the other hand the speed of an attacker was so restrained by sustainment that significant success was not possible. The problem of mobility across "No Man's Land" remained throughout the whole war.[57] This led to change in military strategy and the Great War turned into war of attrition. However, in this example the new technology capabilities were adopted simultaneously by most of the armies. Thus the shift in leading role among the WfFs did not lead to superior operational force employment. Both opponents, especially in the western front, entered the war with equal warfighting systems.

The last example that was selected to clarify the idea for SOF concerns the movement and maneuver WfF. During the period between the world wars, several technological developments made a new shift possible. That was a period in which the rise of air power began, and the period when tanks became the most significant factor on the ground. The German army was the first army, for that period, which used this superior warfighting system. The Germans developed force design that strengthened the use of these new capabilities. They developed and later applied the "blitzkrieg." This was a doctrine that used in an optimal way the capabilities of the new technology and their organizational design. On the opposite side, the French and Soviet armies possessed relatively equal, if not better, technology The French Army incorporated tanks in their doctrine, and so they improved their combat power. However, this improvement was not equal to the structural change made by the German Army.[58] As a result the German Army achieved relative operational superiority. The Soviet Army possessed offensive doctrine

[57]Ibid., 24.

[58]Ibid., 63.

very similar to German doctrine.[59] The lack of commanding military professionals however, made the Soviet Army incapable to fight. Thus the Germans outmaneuvered their opponents with no significant numerical or technological imbalance. The superior warfighting system proved to multiply the combat power again in 1940 and 1941.

Superior tactical force employment (STF) does not exclude superior operational force employment (SOF). Likewise SOF does not exclude the existence of STF. The "Odrin" Offensive of the Bulgarian Army in 1913 is an example. The Bulgarian Army used superior warfighting system in relation to the opponent. This was made by shifting the leading role among the WfFs. To achieve that the Bulgarian High Command reorganized the army's structure, specifically by forming division and army artillery groups or the operation. Their fire was directed and corrected by forward observers, planes, and balloons. Thus the fundamentals of centralized fire control were established[60] and the leading role in WfFs balance was shifted to the fires WfF. The effects of both STF and SOF simultaneously multiplied the numerical preponderance and technology imbalance and influenced the relative combat power estimation. Furthermore, the factor of ETF favored the Bulgarian Army during the "Odrin" Offensive Operation, in the difference in the training and ability of the personnel to use the available weapon

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[59]Ibid., 65.

[60]Nelko Nenov, "Conquering the Odrin Fortress in 1913–Great Victory of the Bulgarian Weapon," *Artillery Review* (Faculty of Artillery, Air Defense, and CIS, National Military University, Shumen, March 2007), 24.

systems, favoring The Bulgarian Army.[61] Thus, what seemed impossible prior to battle, was achieved in short term with a relatively small number of casualties.

Quantifying Force Employment

The historical vignettes offered abovepoint to force employment as a combat power multiplier. This study divided it in two categories: tactical and operational force employment. These two categories were further divided into similar and superior force employment. The dynamic between these four categories is as important as the categories, themselves, and could be explained in the following way. Tactical and operational force employment are separate variables. These variables are always measured relative to an opponent. The existence of superior tactical force employment does not mean that superior operational force employment exists. In fact, poor tactical force employment may preclude superior force employment. The adaptation of newer technology may increase total combat power, but may not lead to superior operational force employment. Tactical and operational superiority are temporary. It is easier for the opponent to adjust to tactical than to operational superiority. However, both of them may lead to victory. When both opponents have equal warfighting systems, only the imbalance in tactical force employment matters.

Similar tactical force employment can be measured. It is determined by the capability of personnel to use the WfFs in optimal ways and the units training level. The analyst should evaluate the degree to which friendly and enemy personnel and units are

[61]Nelko Nenov, "The Victory at Odrin–Triumph of the Bulgarian Artillery," *Artillery Review* (Faculty of Artillery, Air Defense, and CIS, National Military University, Shumen, Bulgaria, April 2013), 23.

capable of using the available systems. Usually this is defined as requirements during training or in peace time. Well trained personnel and units that are capable of using the available systems to theur ful extent should be evaluated as 1, bearing in mind thathe full system capabilities, themselves, are already included in the equation. The inability fully to utilize the weapons and the systems will result in decreased combat power. Thus this variable should be measured as an enabler. Then the value of the similar tactical force employment variable will be into the range of 0 to 1. This is a relative variable which means that friendly capabilities should be compared to these of the opponent in order to reach the actual value. The variable similar tactical force employment is a value that considers multiple measurements of performance. Once determined, the variable should be calculated for only one side of the equation.

Superior tactical force employment should be measured differently. It is a multiplier only for the friendly forces. Such an employment cannot be forecasted for the enemy, becausean opponent’s useof a novelor unknown approach will be a surprise. In that case the variable for STF should be incorporated in the enemy side of the equation. This variable will exist until the friendly forces find an effective way to counter the novel enemy approach. However, in any case the intent to employ a new friendly tactical approach would be known to the planner. Thus he/she may incorporate it in the equation as an additional variable. The equation may have only one, or both, of the tactical employment variables. Based on that, the value for superior force employment, as a multiplier, should be greater than 1. The problem is the ambiguity of that value. Consider the minimal historical force to force ratios needed to succeed in different missions. The author assumed that if these historical ratios were achieved, then the friendly force will be victorious. In the historical examples, the Bulgarians and the Germans advanced against prepared defenses. The minimal historical ratio for success in these missions was 3:1 favoring the attacker. Both examples, however, showed a ratio of approximately 2:1. Inboth cases the technology factor was close to equal, and for the both cases had no significant influence on the result of the relative combat power estimation. Thus force employment emerged as the only missing factor in the equation. In these cases its value should be not less than 1.5, in order to satisfy the needed minimal historical ratio of 3:1. This assumption provides a point for departure in the search for more reliable value.

Similar operational force employment should not be assigned a value. In contrast to similar tactical force employment, which is based on training level assessment, similar operational force employment does not change the result of relative combat power estimation. Similar operational force employment points out that both forces have similar organizational structures with similar WfF balances. At the same time both opponents utilize force design based on the leading role of the same WfF.

Superior operational force employment should be incorporated in the equation. It may lead to victory in the same way that superior tactical employment may. The difference is only in the response time that the enemy has. At the operational level, the enemy will need much more time, as the efforts to change its organizational structure, doctrine, and training will be significant. On the other hand, the result of superior operational employment is the same as at the tactical level: victory. Based on this, the value of both should be same. Biddle offered a finding in his book that is relevant to this issue. Figure 5 represents his point:

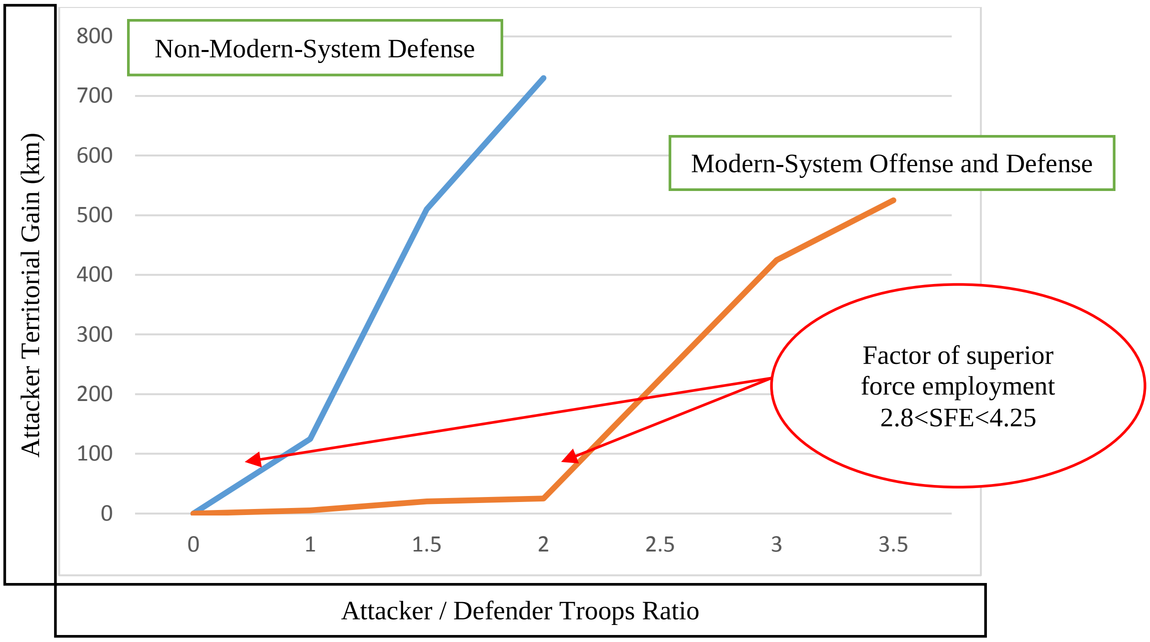

Figure 3. Effect of Preponderance

Source: Stephen Biddle, *Military Power: Explaining Victory and Defeat in Modern Battle* (Princeton: Princeton University Press, 2004), 76.

Figure 3 considers preponderance, plotting territorial gain as a function of theater width of attacker in relation to defender troop strength for the same three force employment combinations[62] (figure 3 does not include the curve for non-modern offense/modern defense, as the territorial gains are minor even for the highest force to force ratio). This chart also may be used to determine the factor of superior force employment. The numerical economy achieved from a superior warfighting system varies for any 100km of territorial gain. However, it is easily. The attacking force that used a superior warfighting system (called a modern system in figure 3) compared to attacking force that used equal warfighting system achieved economy of combat power

[62]Biddle, 76.

from 2.8 for a 100km axis to 4.25 for a 500km axis. Thus Biddle's analysis, as depicted in figure 3, comparesthe differences between utilizing superior and equal warfighting systems in respect to needed combat power. This study adapted Biddle's chart and used these differences to assign a value range for the factor of superiority, from 2.8 to 4.25.

Continuing with the example used thus far in the current study, following is an explanation of how to include the measurementof force employment into the formula for the estimation of relative combat power. As noted earlier in this study, a relative combat power estimation equation should include numerical preponderance, technology, and force employment. Force employment is divided into tactical force employment (TF) and operational force employment (OF). These two concepts arefurther subdivided into similar and superior force employment. Operational force employment influences relative combat power estimation only if it is superior. However, TF influences relative combat power estimation as both similar (ETF) and superior (STF). As similar and superior force employment are always relative, they are incorporated into one or both sides of the relative combat power estimation equation. This is mathematically represented as:

$(N_F \times T_F \times F_F):(N_e \times T_e \times F_e)$ or $[N_F \times T_F \times (ETF \times STF \times SOF)]:(N_e \times T_e)$

In the analysis thus far, after including the technology factor to the result of doctrinal method, the study, using illustrative numbers, reached the following result: 1.4 x F_F : 1 x F_e. To develop the explanatory example the author assigned illustrative numbers for force employment variables, too. Based on achievement oftraining standards, the planner might assess that friendly personnel and units are able to use the WfFs to 80 percent of their optimal level. In the same planning scenario, absent detailed knowledgeabout the enemy, the planner assumes that enemy personnel and units are capable of using their WfFs to their full potential. The value that would multiply the friendly part of the equation would be ETF = 0.8. This is acknolwedgeably a subjective assessment, but one that should be based on available data. For this example the enemy possesses full-scale capabilities, therefore the value of the force employment variable for the enemy side of the equation is 1. That is the way this study measures the similar tactical force employment. If the planner does not anticipate STF and there is no SOF than STF = 1 and SOF = 1. In this example, the result would be:

$[N_F \text{ x } T_F \text{ x } (ETF \text{ x } STF \text{ x } SOF)]:(N_e \text{ x } T_e)$ or [1.4 x(0.8 x 1 x 1)]:1 or 1.1:1

However, if in the same example the planner anticipates STF and evaluates the friendly warfighting system as superior, than the result would be: [1.4 x(0.8 x 2.8 x 2.8)]:1 or 8.8:1 with the lowest values for superiority. Based on the conclusion from Biddle's analysis (figure 5, above), the highest possible values for STF and SOF are equal to 4.25 or [1.4 x (0.8 x 4.25 x 4.25)]:1 or 20:1. With the addition of the assigned values for superiority in force employment, the relative combat power estimation result for the example rises from 2.8:1 to 20:1, approximately a seven-fold difference. This example demonstrates the possible impact of the multiplicative effect of force employment on the proposed equation.

A Simple Mathematical Model for Relative Combat Power Estimation

The product of the analysis depicted in this chapter is a simple mathematical equation for the estimation of relative combat power. The logic of the model for relative combat power estimation is represented mathematically by the following equation:

$(N_F \text{ x } T_F \text{ x } F_F):(N_e \text{ x } T_e \text{ x } F_e)$

Where (with the left side representing friendly forces):

N_F represents the numbers of friendly forces and N_e the numbers of enemy forces, therefore N_F/N_e represents numerical preponderance;

T_F representsthe effect of the technological capabilities of friendly forces and T_e the effect of technological capabilities of enemy forces, therefore T_F/T_e represents the technology imbalance; and

F_F representsthe factor of friendly force employment and F_e the factor of enemy force employment; therefore F_F/F_e represents the difference in force employment.

The proposed model includes the three pillars of relative combat power as they were determined in this study: numerical preponderance, technology imbalance, and differences in force employment. The result of the doctrinal model (FM 34-130) discussed in this chapter represents numerical preponderance and the WfFs movement and maneuver and fires. The technology imbalance dervies from the imbalance in expected effects of the WfFs sustainment, intelligence, protection, and mission command capabilities. In the proposed model $T_F = (S_f \times I_f \times P_f \times M_f)$ and $T_e = (S_e \times I_e \times P_e \times M_e)$, wherein the meaning of the variables is as follows:

S_f – The effect of capabilities of the friendly WfF sustainment to fully execute its mission in percentage (value ranges from 0 to 1),

S_e – The effect of the capabilities of the enemy WfF sustainment to fully execute its mission in percentage (value ranges from 0 to 1),

I_f – The effect of the capabilities of the friendly WfF intelligence,

I_e – The effect of the capabilities of the enemy WfF intelligence,

$I_f/ I_e = I$ – The imbalance in the effects created by the intelligence WfF capabilities (Its value is relative and is assigned only to one side of the equation. The range of this variable is in a percentage that reflects the imbalance in the effects),

P_f – The degree of which the friendly protection WfF meets the enabling requirements (value of this variable ranges from 0 to 1),

P_e – The degree of which the friendly protection WfF meets the enabling requirements (value of this variable ranges from 0 to 1),

M_f – The degree to which friendly forces are able to use command and control systems to execute the art of command and the science of control (value of this variable ranges from 0 to 1),and

M_e - The degree to which enemy forces are able to use command and control systems to execute the art of command and the science of control (value of this variable ranges from 0 to 1).

Degrading factors P_d and M_d are added to the equation. Theyare situationally dependent and they influence the effect or effects of the WfF(s) that they degrade. Their values range from 0 to 1. The last pillar of relative combat power is force employment (friendly, $F_{F,}$ or enemy, F_E). Force employment is always relative. It has meaning when two opponents are compared. This study divided it into tactical and operational components, which are further divided into similar and superior. The variables for similar tactical force employment, superior tactical force employment, and superior operational force employment are added to one side of the equation. In the equation their values are as follows:

SOF – The factor of superior operational force employment ranges from 2.8 to 4.25 (when it exists),

EOF – The factor of similar operational force employment. It does not change the result of equation and no value is assigned,

STF – The factor of superior tactical force employment ranges from 2.8 to 4.25 (when it exists), and

ETF – The factor of imbalance in similar tactical force employment ranges from 0 to 1.

Zero should be excluded as a value for any of the variables, becauseeven the lack of one or more of the elements of the equation does not mean that the opponent will not possess combat power. In such a case the planner should consider the positive or negative effects that this situation presents and factor in an increase or decrease of the other elements.

The leadership and information elements of combat power are not included in the proposed equation. The author argues that they are inherently part of all the other components of the equation, therefore their effects are represented in all of the effects and capabilities of numerical preponderance, technology, and force employment. Thus the equation incorporates all the elements of combat power.

The foregoing analysis did not dispute the logic of any of the extant models of re;lative combat power estimation. In fact, their internal logic is incorporated intothe equation that aims to address all of the gaps identified in the analysis. All the effects that were added to the result of the doctrinal model (FM 34-130) were added in the same way as the fires and movement and maneuver effects had been incorporated into the original model. Thus, all the effects multiply the numbers. Bearin g this in mind, the proposed model should not be characterizedas a departure, radical or otherwise, from the extant models for relative combat power estimation. Rather, it should be viewed as an improvement to those models. Built on this foundation and the analysis presented above, the end product of the study isthe following simple mathematical equation for relative combat power estimation:

$(N_F \times T_F \times F_F):(N_e \times T_e \times F_e)$ or

$[N_F \times (S_f \times I \times P_f \times M_f \times P_d) \times (ETF \times STF \times OF)]:[N_e \times (S_e \times P_e \times M_e \times M_d)]$

Chapter 4 Summary

The analysis chapter provided a brief review of the doctrinal meaning of combat power and the meaning of relative combat power. Extant models for force-to-force comparisons or relative combat power estimation were subjected to critical review. The review highlighted some shortfalls in the reliability and utility of these models for operational planning through anadaptationand application of structured, focused comparison. The review did not argue the internal logic of the extant models,but sought to reveal the gaps in them. The US Army Design Methodology was adapted and applied to develop a solution for filling these gaps. This application consecutively applied the three pillars of relative combat power–numerical preponderance, technology, and force employment. The chapter analyzed technology as a function of the WfFs and suggested a way to quantify the technological imbalance between two opponents. The study presented several historical examples that aimed to explain the author's idea and logic regarding force employment, and explained how that logic leads to quantifying force employment variablesthat currenr models and doctrine regard as intangible. The end product of the analysis was a rendering of the logic of the proposed model as a simple mathematical equation.

CHAPTER 5

CONCLUSION

> So What. These are the two most important words in the analyst's vocabulary. The question summarizes the end state, the derivation of meaning from the analysis he has conducted.
>
> — FM 34-3, *Intelligence Analysis*, 2000

Research Purpose

The purpose of this research was to propose a way to improve relative combat power estimation, which way could be applied in the planning process. The secondary aims of the study were to explore some current models, to reveal the dynamic between numerical preponderance, technology, and force employment, and to operationalize that dynamic. The research achieved its purpose by introducing a new approach to the problem, albeit one that remains to be tested through further research, application, and empirical study.

This chapter briefly highlights and gives interpretation to the findings from analysis chapter. It explains the meaning of the results and points to their possible implications. The conclusion also offers recommendations for further study. This chapter takes into consideration things that could have been approached differently. At the end of the chapter, the author proposes some potential applications of the results of the research for military practitioners.

The Findings and Their Significance

In chapter 4 an adaptation of the methodology of structured, focused comparison was applied to three models of relative combat power estimation. The comparative analysis strongly suggested that the doctrinal model found in FM 34-130, Wass de Czege's model, and Barham's Relative Combat Power matrix have limitations. The comparison revealed gaps that the current study addressed by adapting and applying the U.S. Army Design Methodology. The thesis suggested that an improved model for relative combat power estimation should be built on three pillars: numerical preponderance, technology, and force employment. The author discussed six of the elements of combat power, the US Army's WfFs, as representatives of the technology factor in their respective areas. Personnel,although an integral part of the WfFs, found a better fitas part of the force employment factor. Thus the study proposed a way to measure the influence of both technology and force employment. The result of the analysis was led to simple mathematical equation. The proposed equation incorporated the aforementioned three pillars and addressed the elements of combat power. The overall result of the analysis is a proposed way to measure and incorporate variables, previously assumed as intangible and unquantifiable, into a relative combat power estimation model.

The possible implications of the proposed model include support of situational understanding, the decision-making process, combat power analysis, and force design. It presents a way to explore the opposing force, and especially to discover its strengths and weaknesses in respect to the friendly force. The model iimproves upon the doctrinal model, while retaining its internal logic. At the strategic level, the model presents an opportunity to evaluate a possible enemy, to reveal the center of gravity of its forces, and to enable the design of one's own forces in the most appropriate way in order to deter or, if necessary, destroy that enemy. At the operational level, the model may reveal the way to shape a battlefield or theater of operation, in order to achieve a relatively superior warfighting system. Finally, at the tactical level, the application of this more precise equation may allow the commanders to more effectively and efficiently allocate proper resources over time, space, and purpose. Thus, the proposed model should contribute to an increase in the efficiency of own forces, and greater effectiveness in gaining, retaining, and exploiting the initiative from the beginning to the end of battle.

Further Research

The nature of the problem and the ideas that were presented in the study raise the needs for additional research in several areas.

One area that needs further research regards the assumptions that underpin this study. The author organized the study based upon two core assumptions. The first assumption accepted the numbers of Historical Force Ratio (figure 3) as satisfying the requirements for minimal relative combat power for different missions. The second was needed to highlight the reasons for success and failure. The study argued that commanders who failed in their missions had not been capable of properly estimating the relative combat power ratio. However, further research, although beyond the scope of the current study, is needed to confirm the validity of these assumptions.

Another area for further research is the method for calculating the value of superior force employment factor. Although the study made an initial - and, arguably, tentative - interpretation of the results of Biddle's research, a deeper analysis is needed.

This is because Biddle's definition of "modern system" differs from the definition for "superior warfighting system" provided in the study. Furthermore, research of historical case studies should be made in order to confirm or deny the proposed value range for the superior force employment factor.

The paper also raises the need for further research in the area of the capabilities associated with the WfFs. The practical utility of the proposed model hinges, to an extent, upon the development of a methodology for comparison of different WfFs' capabilities. The model also needs a methodology for evaluation of anticipated effects, which are result of the imbalance of the capabilities. Such methodologies will allow the analytical process flow to be faster even at lowest tactical level.

Lastly, and perhaps most importantly, the proposed model and mathematical equation need to be tested and validated.. This could be done through historical research and computer-supported simulation. The historical research may be focused on battles that have clear victors and no obvious relative combat power imbalance. Computer-supported simulations may be used to manipulate the organizational structure of the opponents in order to explore the influence of a superior warfighting system and to confirm or deny the range of the superiority variable. That being said, this study makes no pretension to offer the final word on a more effective way to estimate relative combat power. To the contrary, it signals the start of a conversation in the communities of academics and practitioners as to its utility and effectiveness as a tool for planning at various levels of warfare and force development. It is to the last point – the utility of the model for force development–that the study now turns for its concluding words.

Summary

It was the author's initial intent to propose a way to facilitate the organizational restructuring of his service, the Bulgarian Army. However, time constraints did not allow for thorough research to be made in the force design area. The proposed model could be used by armies that are undergoing reform, such as the author's, the Bulgarian Army, as a framework for force design and the buildup of the armed forces. As the Bulgarian military "reform" is close to its end the "hybrid threat" concept is no longer practical. The model proposed in this thesis frames a way that could be utilized once the real threat is determined. It provides an approach to evaluate the organizational structure of an opponent and its overall combat power. The model may be used to guide the evaluation of the current state of science and technology in order to accept or deny the possibility of shifting the leading role in WfFs balance. Thus, at the strategic level, economies in the allocation of resources may be achieved. Such efficiency becomes even more important when an army buildup takes place in an environment of highly constrained resources. At the operational level, the model may be used to determine the way of shaping the battlefield or theater of operation. The buildup of one's own forces is not the only way to establish a superior warfighting system. The same result could be achieved by destroying or temporarily disrupting elements of the enemy structure. A leader or commander, by applying the proposed model,would be able to plan, prepare, and execute series of engagements and battles employing sufficient combat power to gain a position of relative advantage and fulfill the mission. Once understood and put into practice, this model of thinking on relative combat power couldl allow Bulgarian Army officers and decision makers to organize and employ in an optimal way the available resources by time, space, and purpose. This is the road to victory.

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